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NATIVE METHOD OF SETTING GILL NETS, ON BEACH NEAR PACIFIC STEAM WHALING COMPANY'S CANNERY, NUSHAGAK BAY.

NORTHERN AND INSHORE POT OF SALMON TRAP, NEAR GRAVEYARD POINT, KVICHAK BAY.

View from beach at low tide, showing tunnel down; steamer "Sayak" at anchor beyond.

SALMON INVESTIGATIONS OF THE STEAMER "ALBATROSS."

SALMON INVESTIGATIONS OF THE STEAMER "ALBATROSS" IN THE SUMMER OF 1900.*

By Jefferson F. Moser, Commander, United States Navy, Commanding.

The commercial salmon fisheries included in the division laid out in my previous report as the Bering Sea district are confined entirely to Bristol Bay, and if the wide limits ascribed by some to this bay are accepted, the canneries and fisheries are all in the northeast section or on the rivers that empty there. One authority states that "Bristol Bay may be said to include all that part of Bering Sea lying east of a line drawn from the northwest cape at Unimak Island to the Kuskokwim River." In my opinion, a better western boundary, topographically, would be a line from Port Moller to Cape Newenham.

The commercial salmon fisheries of this district are on the Ugashik, Egegak, Naknek, Kvichak, Nushagak, and Wood rivers, and their sea approaches. These rivers are all large, with large lake sources, and, except Wood River, drain the western slopes of the mountain range that traverses the Alaska Peninsula and extends along the western border of Cook Inlet.

The history of the salmon fisheries of Bristol Bay for commercial purposes is given under the several cannery headings. The earliest record in the history is the salting of salmon on the Nushagak by the schooner "Neptune" in 1883, and the erection of cannery buildings that year for the Arctic Packing Company, which made a trial pack of 400 cases the year following (1884). It is noticed, however, that Petroff, in the census report of 1880, states:

"The salmon family, the great feeder of all the Alaskan people, frequents in astonishing numbers the Nushagak and other streams emptying into Bristol Bay. The facilities for building traps and weirs are also extraordinary, and American fishermen have for some years been engaged here every season in reaping a rich harvest and shipping the fish, salted in barrels, to market. Hundreds of barrels have been filled with a single clean-up of a trap. The only drawback to this business is the short period over which the run extends, necessitating the employment of a very large number of hands while it lasts. . . . Exports from this section have thus far been limited to from 800 to 1,200 barrels of salted salmon per annum from the Nushagak River."

It is probable that this latter reference was to the salting done by traders on a limited scale. The Alaska Commercial Company, or their agents, salted salmon at various stations prior to 1880, and, as they had an important station at Fort Alexander, on the Nushagak, it is probable that some salting was done there.

FISHING METHODS AND FISHERMEN.

Two methods only are employed in taking salmon for commercial purposes in this district, viz., by gill nets and by traps, and both are well adapted to the local conditions.

The strong currents and comparatively narrow deep-water channels, together with the discolored water, permit the use of gill nets with great success. The dimensions of the nets vary according to the depth of water and the individual ideas of the different cannery superintendents. For redfish the length varies from 75 to 80 fathoms; the depth from 20 to 26 meshes, and the mesh from 6⅛ to 6¼ inches stretched. For king salmon the length is from 120 to 125 fathoms, the depth 24 meshes, and the mesh 9½ inches stretched. Floats are rigged 3 feet apart and leads 2¼ feet apart. The average value is about 65 cents per fathom, depending on the market and the quantity purchased. The large companies use a great amount of web, and have special arrangements with the manufacturers. By watching the market closely and buying when the price is low they have a great advantage over small operators.

The gill-net boats used on the Nushagak and the Ugashik are regular Columbia River boats, built in San Francisco at an average price, complete, of $200. The usual dimensions are: Length, 25 feet 1 inch; beam, 7 feet 8 inches; depth, 2 feet 6 inches; capacity, 300 cubic feet. They have a centerboard and spritsail, and will carry, as an extreme, 1,400 redfish. The boats used on the Kvichak, Naknek, and Egegak are flat-bottom double-enders, about 1 foot longer than the Columbia River boats, but have the same rig and the same capacity, and on the water resemble them very closely. Their value is about $100, complete. Two men form a gill-net crew—a netter and a boat-puller. They work on tides, and when the fish are plentiful remain near the canneries, but when the run is slack they may drift 15 or 20 miles away.

Traps, used extensively in the Bristol Bay district, are a subject for criticism throughout Alaska. They are expensive to build and maintain, but have many advantages to the canner. The great benefit of a trap is not only that it fishes day and night, but, if the run is heavy for a few days and the cannery fully supplied by the gill-netters, the fish in the traps can be held for a time until the catch of the gill-netters is slack. These advantages have frequently led the trapmen beyond the limits of the law, and the time has come when the use of traps must be regulated and the law enforced, or else they must be abolished. Having in mind now the whole of Alaska, it is my opinion that if this be not done they will work a great injury to the fisheries.

Traps catch not only the salmon wanted, but all other species of salmon and other fish not wanted. Practically all fish taken in the traps, except redfish, are waste, and until one sees the tons of this waste product, one can not realize the magnitude of this giant octopus that grasps everything in its tentacles.

Fish were very plentiful this year, and the gill-netters were able to supply most of the fish used. It was said on this account that traps took more fish than were wanted, and that they were frequently opened to let the impounded fish escape. This statement may be true, but there never was a cat that held a mouse with more tenacity than a canneryman holds a salmon, and it is doubtful if a salmon of choice species is ever allowed to escape as long as it is fit to put inside a tin can.

I have said here that practically all fish taken in the traps, except redfish, are waste. This should be slightly modified, though practically it is true; yet, in justice to the cannerymen, it may be said that the records of the past few years show that, besides redfish, on the average less than 8,000 cases of king and 8,000 cases of all other species were packed per year in the whole Bristol Bay district, and some of these no doubt were taken in traps.

There is a question arising in my mind which now can only be stated and left for the future to decide, as follows: Traps take all fish of all sizes; gill-nets take only the large fish; will gill-net fishing result in decreasing the size of the fish?

In one locality trap men informed me that trap fish are more expensive than gill-net fish. In another place it was said that this year two gill-net boats secured more fish than one trap, but when asked why the traps were maintained the reply was that the fish were held in the traps until wanted.

One canneryman, whose resources seemed limited and who did not feel able to maintain traps, frankly said that traps should be abolished; but, when asked if he believed that traps were injurious to the fisheries, he was equally frank in saying "No." The motive is evident.

The traps consist of the usual shore and channel leads, with hearts and pots, but there are all kinds of variations to meet local conditions or the fancy of the "trap boss." Some have two pots and some have additional appendages in the shape of corrals.

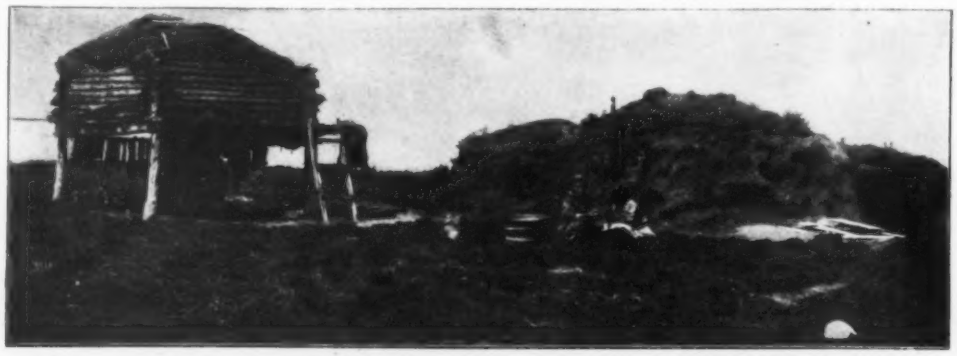
Not only is the first cost of a trap in this country large, but its maintenance forms a big item of expense. All piling must be imported, and the strong currents frequently damage both piles and web. The piles are pulled up when fishing ceases on account of the ice, and are redriven in the spring as soon as the ice is out of the river and before the fish begin to run. The largest trap seen in the Bristol Bay district had about 2,700 feet of leads laid out in a rather complex way, with two pots, 75 feet by 75 feet, and a large corral.

Seines are not used in this district, largely on account of the strong current, although this could be overcome if there were good seining beaches. There are a few bowldery beaches, but, as a rule, the banks and beaches are soft mud, so that at low water landing at many points, if not impracticable, can only be effected with great effort. On one occasion, in landing at low water near a cannery on the Nushagak, we became mired to such an extent that it was only by clinging to a bidarka, pushed out to us by the natives, that we were extricated and hauled ashore.

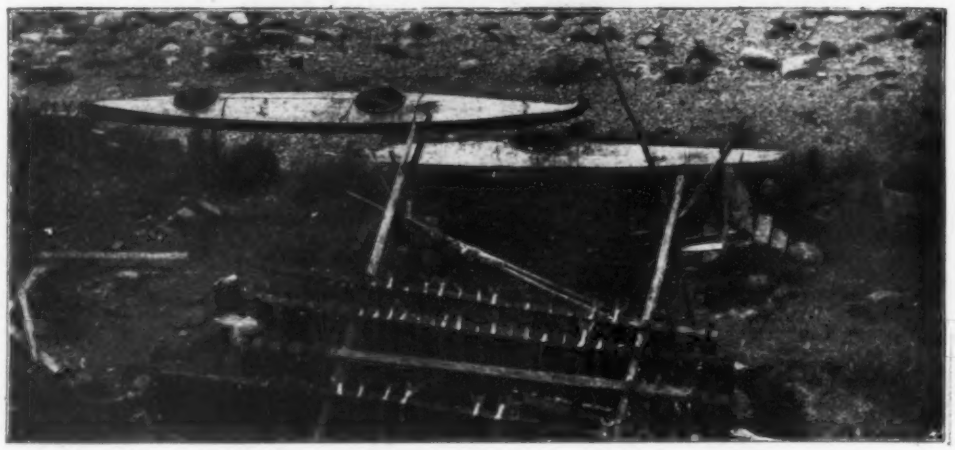
The fishermen are white, usually foreigners, chiefly Scandinavians, with some Italians. They contract with the cannery for the season, and receive $50 per man for working the cannery ship from the home port to the cannery and back, discharging and loading the vessel at the cannery, getting the nets and boats ready, and doing other beach work until fishing begins. They receive full and excellent board and lodging from the time of leaving their home port until their return. The wages of trap and beach men are $30 per month and one-third cent per case. The gill-netters and boat pullers receive 2 cents for each redfish and 10 cents for each king salmon per boat of two men, the fish being delivered and tallied at the cannery or to a tender of the cannery. During a good season they average as high as $75 per month. If during the fishing season a man is taken from his boat to do other work, he receives as wages an amount equal to the average share of that day.

When the run is heavy and more fish are supplied than the cannery can use, the fishermen may be limited in their catch to 1,000 a day, but not under that amount. It is not rare, when redfish are plentiful, for industrious and expert netters, by working early and late, to make two loads, or 2,400 fish, which nets $24 to each man in the boat. This season it was noticed at three places that limits of 1,000, 1,100, and 1,200 redfish, respectively, were placed on the boats, and with the first limit at one cannery it was necessary to take some men out of the boats to clean fish, the Chinese being unable to keep up the supply for the machinery. These men, therefore, received $10 per day for butchering.

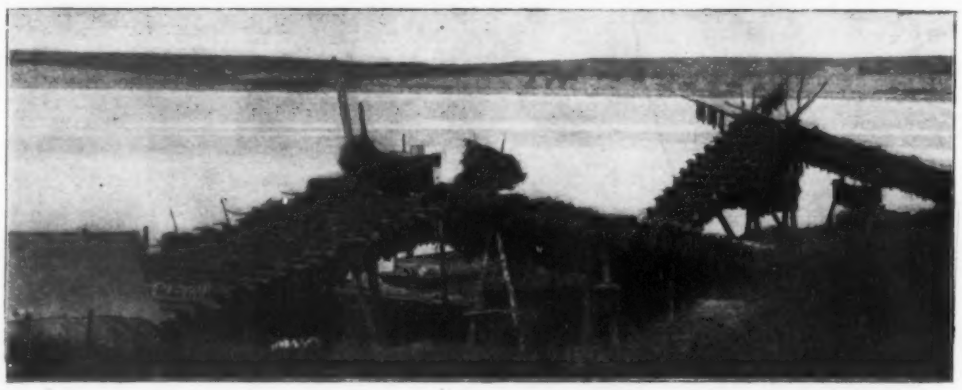
Unless one has seen the bins of a large cannery in running order words cannot fully convey an impression of the masses of fish used in a single day. A thousand salmon seems to the ordinary observer a large number, yet a single three-filler cannery will



NATIVE BARABARA (SOD HOUSE) AND STOREHOUSE, NEAR NAKNEK RIVER.



BIDARKA AND KAYAK ON BEACH, UGASHIK RIVER.



UKALA RACKS NEAR CANNERY OF ARCTIC PACKING COMPANY (A. P. A.), NAKNEK RIVER.

On the left is a typical diminutive tent, such as is used by the Bering Sea Eskimos and Aleuts.

SALMON INVESTIGATIONS OF THE STEAMER "ALBATROSS."

* Abstract from U. S. Fish Commission Bulletin for 1901.

utilize each day 25,000, and this district, when running full, will pack each day 250,000 in its thirteen operating canneries. It is difficult to understand how it is possible to maintain the supply, although the run is immense.

In Nushagak Bay, off Clark Point, on two occasions the fish were running so heavily that they were caught in the propeller of the launch of the "Albatross," stopping the engines.

The season in Bristol Bay is short. Not only do the fish run a very limited time but good weather lasts but a few months, although the conditions are far more agreeable during the summer than over Bering Sea generally. There are many bright, sunny days, frequently quite warm, fewer gales and less fog, but with September come the gales and cold.

The cannery ships try to reach their destinations as soon as the ice will permit them to enter the bays, as there is only a short time after their arrival to make the necessary preparations before the runs begin. They expect to arrive not later than the middle of May, and to do this they must enter Bering Sea early, often encountering much ice to the eastward, though the rivers may be mostly clear. Cannery steamers (tenders) sometimes reach their destinations in April, but frequently are obliged to lie outside or to haul into a mud slough at high water and lie ashore until the rivers have discharged the floating ice.

Bristol Bay is essentially a redfish district, and while all other species occur they do not run in large numbers. They will be referred to under the cannery headings.

When the vessels arrive in May there are no salmon in the streams, even for the cannery tables. The earliest arrivals are king salmon, which appear from June 6 to 16, depending upon the river conditions. They are followed a few days later by the redfish which, about June 16 to 20, run in sufficient numbers to warrant operating the canneries for them. The king salmon run scatteringly throughout the season; traps, drying and storing the nets, hauling out the fishing boats, and loading the transport vessels. When the cargo is on board, lighters, scows, and tenders are hauled out and put under cover, the doors are closed, the watchman takes charge, and the ships sail away with the pack and the human freight.

Cannery men expect to be "cleaned up" in this district by the middle of August.

CANNERY WASTE.

The waste in the Bristol Bay district is strikingly large, due, in the first place, to the greater abundance of fish, and, secondly, to the necessity of rushing the pack on account of the short season. To the novice who is accustomed to see fish only in a market, where salmon are sold at from 10 to 20 cents per pound, this waste is the first thing to impress him. It is probably within the limit when it is said that the waste in this district for the present year is not under 50,000 cases of redfish alone. The waste here referred to is in marketable salmon, and does not include other fishes wasted in the traps or nets. It runs through the whole process, from the time the fish are captured until the last tapping test is made.

The largest waste comes from holding the fish until they are unfit to pack and then throwing them away. This may occur at the traps, in the tenders, or in the fish-bins. Many are lost in passing from fishing boat to receiving scow; others again in pewing from scow to fish-house. In this district only three cuts are made, the end pieces being thrown away; then comes the waste in machines, which, including the loss of the tail pieces, is 32 per cent greater than with a careful hand-filled pack.

The do-overs should also be considered waste, though they reach consumers in out-of-the-way places. A certain percentage is unavoidable, but in a well-conducted establishment this should not exceed 1½ per cent. In this district it is over 4 per cent.

In front of every cannery in this district, and along

HUMPBACK SALMON ASCENDING LOW FALLS, LITNIK STREAM, AFOGNAK ISLAND.

SALMON INVESTIGATIONS OF THE STEAMER "ALBATROSS."

but even on the Nushagak, the only Bristol Bay locality where a regular pack of this species is made, they cease fishing for them soon after the redfish commence to run, as the latter is the more profitable fish. King salmon are nowhere abundant in this district and the few taken in the traps and redfish nets after the packing of the former species is closed are used on the cannery tables, or their bellies are salted for personal use.

It is said that there is quite a run of cohoes after the canneries have "cleaned up." A few are taken at the close of the redfish run, and it is probable that they are present in numbers until cold weather sets in.

The canneries are practically in full operation about one month, as the redfish run is over by July 20 to 25, and during this time they present a busy scene; every one is worked to his full capacity, and nothing is thought of, talked of, dreamed of, but fish. The hands of the clock are moved ahead in the morning, righted at noon, and moved back in the evening to gain time; work starts by 3 in the morning, and the bathroom is frequently not cleaned up, if it is cleaned at all, until 10 and 11 at night. The employes appear weary; the Chinese, never very robust-looking, seem to drag along as though they would drop in their tracks. The tinned fish, after cooling, are stacked in great warehouses, for there is no time to lacquer, label, and box, as the energy of the whole force is concentrated in putting fish into tin cans and sealing them. The leaky cans accumulate, as the menders can not keep up with the work, resulting in a large percentage of do-overs. At last, when the force is about exhausted, a respite comes; the run slacks and there is a sigh of relief by all except the superintendent, who swears that he has not packed enough, though every can may be filled. The relief is only temporary, however; the lacquering, labeling, testing, and boxing must now be done, and there is a rush for the final clean-up, all being eager to take their departure. While the Chinese are engaged in lacquering, etc., the fishermen and the beach gangs are pulling up the the beaches for several miles, thousands of dead fish are seen. Usually the tide serves well and carries other thousands away, but sometimes the wind is unfavorable and winrows of decaying fish, a hundred feet in width, along the beach, testify to the enormous waste during a canning season.

There is another source of waste that may be mentioned, which consists of the king salmon, the finest salmon that swims the Pacific waters. This species does not run abundantly anywhere in Alaska. An average of less than 8,000 cases are packed in the Bristol Bay district, of which all but a few hundred are packed on the Nushagak. They run, however, in a scattering way in all the rivers where packing is done. Very few are canned after July 1, for the entire energy is then bent upon the redfish. As a few king salmon are taken every day during the season in the traps and nets, the bellies of those not used on the cannery table are cut out and salted for private use, and the remainder of the fish is frequently thrown away. Great, beautiful fishes, weighing from 25 to 40 pounds, from which the bellies had been removed, were seen at several places lying on the beach, to be carried away by the tide or consumed by the birds.

INFLUENCE OF WINDS ON MOVEMENTS OF FISH.

So far as observations have been made it has been noticed that the salmon in inland waters, and upon approaching them, swim at a depth estimated at from 6 to 12 feet below the surface, and that they favor a course with the wind in approaching fresh water. At Koggiung, Naknek, and Egegak the southwest winds bring an abundance of fish during the run. At Ugashik the southwest winds are best, but northwest winds are also favorable, while on the Nushagak it is claimed that south and southeast winds give the best results in the fisheries. Upon examining a chart it will be noticed that these directions of winds are over the sea and toward the several localities mentioned. As before noted, in midsummer the weather over the land in the Bristol Bay district is frequently quite warm and sunny, often too warm to keep the fish in good condition very long. It is claimed that cold weather, with light rain, gives the most favorable conditions for the successful operation of a cannery.

SALTING.

Every cannery in Bristol Bay, or, if more than one cannery in a locality is operated under one management, then every group of canneries, is fitted for salting salmon. When the fish run in such numbers that the cannery can not utilize all, the surplus goes to the salting tanks. Practically all the fish used in this manner are redfish, of which 16,778 barrels were salted in 1900 and in addition 558 barrels of king salmon.

During 1900 there was but one saltery operated solely as such in this district. It is situated on the Nushagak and had an output of 7,186 barrels of redfish and 536 barrels of king salmon for the season.

It is claimed that if salmon are dry-salted in kenches, and then boxed or barreled, they will become rusty, though this method was practised in several instances in southeast Alaska this year. The usual method in Alaska is to salt the fish down in wooden tanks or vats, and leave them until they are thoroughly shrunk and water in them has been replaced by brine. They may then be washed out at any time and resalted into barrels.

It is very difficult to obtain correct salting statistics, but the following, taken from the books of the Merchants' Exchange at San Francisco, may at least show the variations in different years:

Total Pack of Alaska Salt Salmon.

	Barrels.
1889	6,930
1890	13,417
1891	8,913
1892	17,895
1893	21,290
1894	29,096
1895	14,234
1896	7,700
1897	15,127
1898	18,718
1899	22,872
1900	17,687

Formerly from 46 to 47 redfish were counted as making a full barrel of 200 pounds of the salted product in this district. Inquiry at different places this season showed that the number ranged from 48 to 52 redfish to the barrel. The largest saltery averages 50 redfish, 50 cohoes, or 14 king salmon to the barrel.

For other saltery notes reference is made to my former report, page 21.

CANNERIES AND CANNERY METHODS.

The general methods are quite similar in all canneries, though the arrangement of buildings and machinery, the amount of the latter, and the detailed appliances differ materially. There seems to be no standard; a cannery is built and arranged according to the individual ideas of its superintendent, and no two appear to be alike, except a few built by one company, which all seem badly arranged. It is rather surprising that some model cannery is not constructed as an object lesson.

It is not my intention to lay out a plan for a cannery, but simply to make a few suggestions and point out special features which may improve them. A cannery building should have an abundance of light, be thoroughly ventilated, well drained, whitewashed inside, and washed down with a steam hose every working day. A three-filler cannery should have a width of at least 50 feet, and the length should correspond to the machines used in processing, giving ample room, so that the cans may go uninterruptedly throughout the whole length of the building. If the ground will not admit a building long enough to have the bathroom on the extension, the latter, with the boilers, may be located in an ell. From the door where the fish are received to the bathroom, except the mending tables, there should be nothing but the machinery and appurtenances for processing the fish. A second floor may be necessary over the filling machines for the storage of cans and for the purpose of feeding them from an elevation, but it were better to feed with a traveler and leave the roof clear for skylights and ventilation. If, however, a second floor is insisted upon, it should be double-layed, one course diagonal, to keep out infiltration of dust and dirt over the machines. A separate two-story building, parallel with the cannery, and joining it by a platform at least 40 feet wide, should be erected for a warehouse, the platform to be used for a cooling space.

The fish-house should be over the water at all stages of the tide, so that boats and lighters may discharge at any time, and the muck and gurry be carried away by the current. The other buildings, the mess-houses, bunk-houses, etc., should be placed conveniently, having due regard for protection from fire.

A very convenient rigging for transferring fish from the boats to the fish-house was noticed at a cannery where there is a large rise and fall of tide, uncovering a flat in front of the building. An inclined plane led from the side of the fish-house to below the low-water mark, and a car operated by cable and steam traversed the plane. The fishing boats hauled on either side at all stages of the tide, and, lying at the same level, tallied the catch into the car, which, when full, was run to the fish-house and unloaded by dumping.

At another cannery, where fish are conveyed to the cannery by steam tenders, an inclined plane was used, extending to deep water, having the end V-shaped, admitting the cannery steamer into the V and allowing her to discharge from either side. In this case the filled cars were run over an elevation into the bins and then dumped.

In a locality where the conditions did not permit the fish-house to be located over the water at low tide, and where the cannery supply of running water was large, an immense hopper was built under the floor, with an inclined trough, through which the gurry was washed by a constant stream.

In a few canneries it was noticed that each fish-cleaning table had a spray of water from several jets

playing over it, thus washing off the blood and gurry. This feature might be more extensively copied, as it promotes cleanliness in a place which is never too clean or free from odor.

At several canneries a neat and satisfactory contrivance was seen in operation for transporting fish from the fish-house to the cannery, which consisted of a shallow trough having for its bottom an endless chain of buckets. As a neat addition, a spray, formed by a perforated pipe about 8 feet long and suspended over the buckets, washed the fish while passing under it.

A new solderer was noticed, having, instead of the endless chain to give motion to the cans, a metal spiral running the length of the machine and revolving on an axle through the center. Each loop grasped a can and followed it to the end, thus giving the cans the proper motion and preventing them from rolling side by side and lapping the solder over the ends, as is frequently the case with the chain machines.

An effective contrivance was seen by which the can, after leaving the solderer, was turned upon an endless belt so as to permit the solder to set into the top, and carried upright for a distance of about 20 feet, when it was again turned on its side automatically and rolled under the cooling spray. New retorts with quick-closing doors were also seen.

The Alaska Packers Association sent several fish-cleaning machines into the field for trial, but none was seen in operation. It is understood, however, that one, the invention of William Munn, the superintendent of the cannery at Alitak Bay, has been perfected after several trials, and it is said to work so satisfactorily that a number are now under construction for the season of 1901. If a machine for fish-cleaning can be successfully operated it will be a great boon to the canneries.

Can-making machines are now being extensively introduced by the Alaska Packers Association, and the season of 1901 will probably see all their canneries equipped with these machines. A set consists of one cutter, which cuts the sheet tin into exact lengths for the bodies; one body maker, which forms the body, makes the seam, and solders it; one topper and one solderer, both of which are of the same form as those used in the cannery. In the can-making department there are also dies operated by steam for cutting tops and bottoms and an extra one for cutting ficats—the small piece of tin used inside the can under the top to keep the vent clear in processing. The feed for the plate in the body-maker seems to be the most imperfect part of the machine, causing frequent jams; but even allowing for delays due to these jams, a set will turn out an average of fifty cans a minute.

BRANDING SALMON.

Attempts have been made at different points on the Pacific coast to mark salmon, and it would be interesting if the facts in all cases were recorded as well as the results. It is well known that at several points young salmon have been marked by cutting off the fleshy (adipose) fin; but, unfortunately, this seems to be the only method offering any facility for marking these fishes, and if all localities adopt the same system but little benefit will be derived.

My attention has, on several occasions, been invited to so-called marked fish other than those from which the fleshy fin had been removed, and it may be of some interest to give a brief description of them. In 1897 it was called to a mark on the gill cover of a redfish at Uyak. The mark was elliptical in shape, with three-fourths inch and one-half inch as the respective major and minor axes; the edge appeared milled, and there were some blurred marks around the inner circle, while in the center there was a design which might be taken for a crown surmounting a sphere. At San Francisco, in the office of the Alaska Packers Association, a similar mark, also on the gill cover, is preserved in alcohol. This year, on the Nushagak, a mark of the same kind, though less distinct, was seen on the gill cover of a humpback. My first impression was that these marks had been made by a coin, but this would be impracticable unless made on an adult fish. It is my belief now that the mark is that of some parasite which had become firmly attached to the gill cover and left its impression. This year two redfish were taken on the Nushagak that had the dorsal-fin rays entirely removed and the skin was apparently joined smoothly over the back.

One fish was taken in the same locality with an impression resembling an M or a W, 1¾ inches square on its side; and another with the same letter, and a scroll drawn out from the end. At Koggiung two fish were taken with the M or W marks, and one with H W or M H. These marks were midway on the side of the fish, brown in color, and apparently the scales were wanting in the wake of the lines, which had the appearance of having been traced with an iron. It is doubtful if young fish can be marked in this manner, and the suggestion is offered that it is possible that the marks may have been produced by the fish lying on a piece of webbing in the bottom of the boat, and that the fish piled on top may, under proper conditions, have furnished sufficient pressure to form the marks.

THE NAVAL WAR GAME BETWEEN THE UNITED STATES AND GERMANY.—XII.*

By FRED T. JANE.

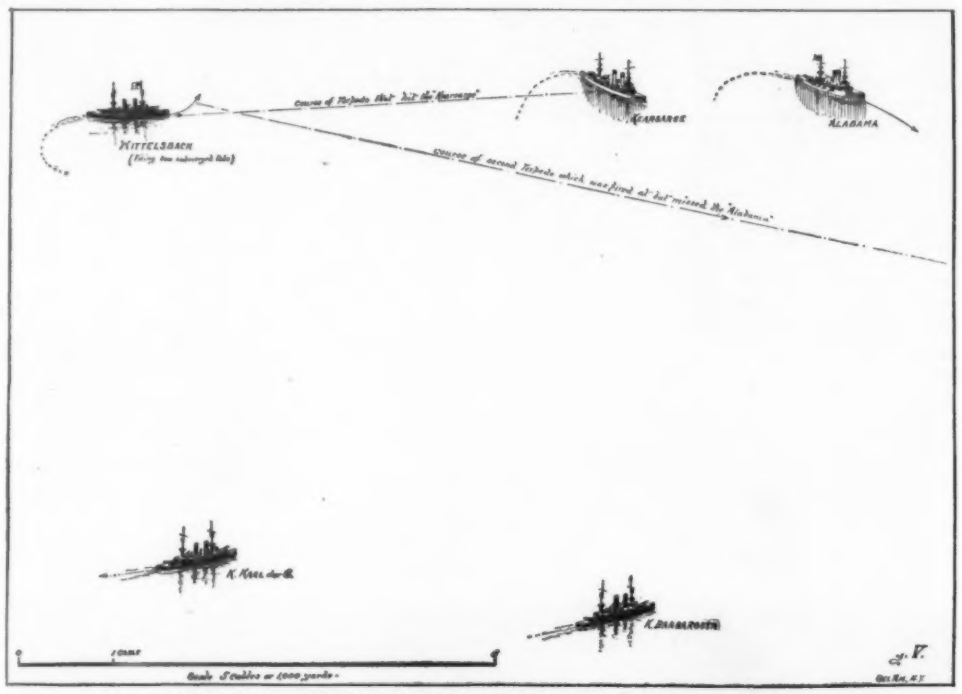
SEVERE DEFEAT AND DESTRUCTION OF THE GERMAN FLEET IN THE FAR EAST.

WITH the other divisions things did not go so simply. Battered as were the two "Kaiser" class ships, the "Wittelsbach" was practically untouched. The American vessels were by no means so well off, both of them had received big shells in their R. F. batteries, and the after turret of the "Kearsarge" was out of action. Of all five combatants only the "Wittelsbach" was in perfect steering trim.

Of this the "Wittelsbach" took instant and brilliant advantage. Going full speed she was soon astern of the "Kearsarge," which could not reply with a single gun, her stern being demolished or nearly so.

At 1,000 yards the "Wittelsbach" slowed down and fired her bow submerged tube. It took effect, and the "Kearsarge" went down.

This left three Germans pounding the "Alabama," now in a bad way. Circling round, the "Wittelsbach"


Course of Torpedo that hit the Kearsarge
KEARSARGE
ALABAMA
WITTELSBACH
(Firing two submerged tubes)
Course of second Torpedo which was fired at but missed the Alabama
K. KARL DER G.
K. BARBAROSSA
1 CABLE
Scale 5 Cables or 1000 yards.

FIFTH STAGE. TORPEDOING OF THE "KEARSARGE" (ON EXACT SCALE).

fired a broadside tube at her which missed. She then came back to her original course and drew nearer. The "Alabama" meanwhile got off a torpedo that hit the extreme bow of the "Barbarossa," but she was so pounded that but for the fact that the "Ohio" was hurrying to her assistance, she would have been captured.

Seeing the "Ohio" coming up, the "Wittelsbach" rushed the "Alabama," giving her two more torpedoes, both of which hit. The "Alabama" went down.

For a little while the "Wittelsbach" and what was left of the "Kaiser Karl der Grosse" engaged the "Ohio," which kept well out of torpedo range, concentrating mostly on the "Kaiser Karl der Grosse"—the "Kaiser Barbarossa" being past firing. One 12-inch A. P. shell was, however, got into the "Wittelsbach's" battery, whereupon this ship began to make off for Kiao Chau, her consorts having signaled that there was no more fight left in them.

The "Ohio" followed a little way, but a 9.4 shell hitting her conning tower put her out of control and killed the admiral. She fell off, and the "Wittelsbach"—which had the speed gage at this stage—got clear away. The other two German ships, from one of which the fatal 9.4 had come, surrendered so soon as they saw the three "Maines" reforming to attack them.

Thus the command of the sea in the Far East passed to the Americans, and passed relatively cheaply. Out of the five ships they lost the two weakest sunk, and one other, the "Missouri," badly mauled. Two were left in fair fighting trim. The Germans, on the other hand, lost five of their six ships, one, the "Kaiser Barbarossa," sinking soon after the battle, and the ship which got away was in no trim for fighting for many a long day.

Both American admirals had perished, the vice-admiral killed, the rear admiral drowned in the "Alabama." The senior surviving captain in the "Maine" was therefore in command. He at once dispatched the damaged "Missouri" to San Francisco with the prizes, and himself went to Manila with the two intact ships. Here, as he had expected, he received urgent orders to proceed back to the Atlantic without delay. Here the Germans, eluding the monitors without difficulty, were doing serious damage on the seaboard.

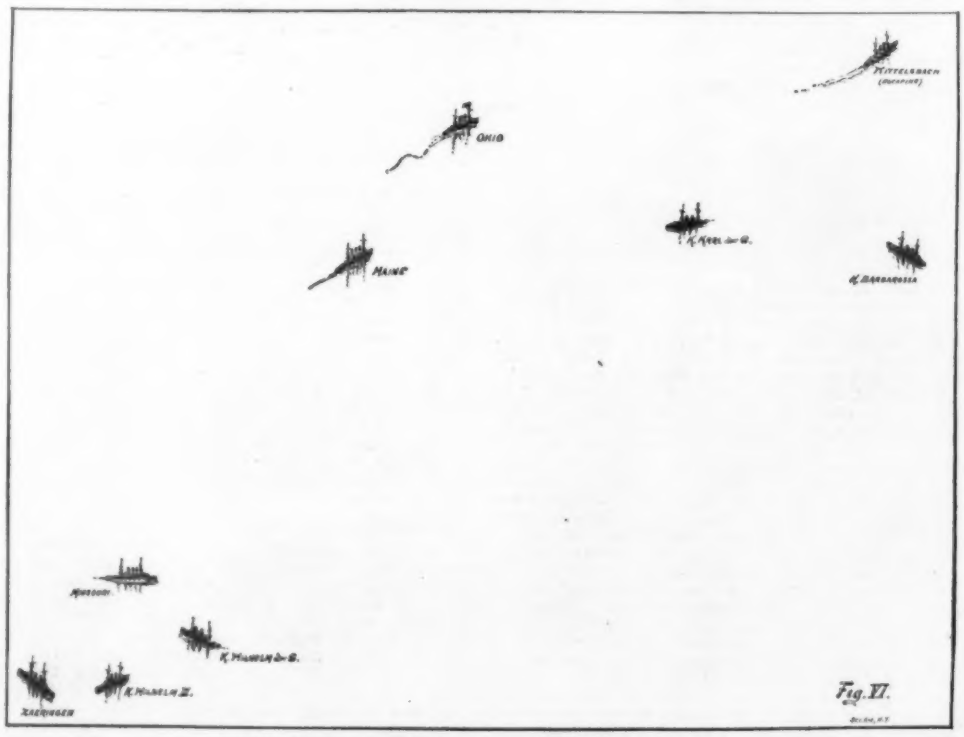
A summary of the guns engaged is as follows:

	13 in.	12 in.	9.4 in.	8 in.	6 in.	5 in.
United States	8	12	—	4	62	14
German	—	—	24	—	108	—

In this, it will be at once apparent that the Germans had a great rapid-firing advantage, while with armor-piercing guns the Americans had the pull. In tertiary pieces (3.4 and 3-inch) the Germans were vastly superior.

This fact determined the American admiral's decison to have his line cut if possible. It gave him a chance to come in with his big guns before these were overwhelmed by the rapid-firers, and he succeeded in accomplishing it.

At first sight the position of the Germans with both broadsides in action looks extremely advantageous. But the advantage is apparent only, because of the disadvantages suffered in getting to the position, and the further disadvantage that immediately followed it. What really happened was that both American divisions as they turned were able to concentrate on the fourth and fifth German ships (the second and



SIXTH STAGE. POSITIONS AT THE END OF THE BATTLE.

DEFEAT OF THE GERMAN BATTLESHIP FLEET IN THE PACIFIC.

* Prepared especially for the SCIENTIFIC AMERICAN by the well-known naval expert and inventor of the naval war game; with exclusive rights in the United States and Great Britain. This series was begun in the SCIENTIFIC AMERICAN SUPPLEMENT of December 28, 1901.

third being then feeble), and so soon as there was danger of the United States divisions hitting each other, the "Alabama" division was able to attack the head and the "Maine" one the tail of the enemy. Thus the Germans were split up into two, and between the effective "Wittelsbach" and "Zaehringen" were four disabled ships. Concentrated German torpedo attack was thus avoided. The different torpedo armaments were:

	Submerged.	Armored Above Water.	Unarmored Above Water.
United States	6	8	1
German	30	6	—

Both sides were allowed the safety pistol for above-water tubes, and all these were loaded except that in the "Kearsarge's" bow. Most above-water tubes were smashed at an early stage of the battle.

The damages received by the captured German ships were of such a nature that they will be of no further use for some time to come, and unless the war is indefinitely prolonged (which is extremely improbable) they will certainly have no share in it.

It remains to add that the Americans just after this battle were allowed by the umpires to have refitted the "Kaiserin Augusta," captured in the first battle of the war. A speed of 15 knots, and an effective battery of ten 6-inch guns, has been allowed her. The ship is at Manila.

The Germans have been allowed the "Detroit," captured in that mid-Atlantic cruiser action which resulted so disastrously for America. Her speed has also been fixed at 15 knots, and the effective armament reduced to eight 5-inch R. F.

A German cruiser squadron with the "Victoria Luise," "Gefion," "Aridane," and "Detroit"—all repaired ships—is fitting out at Kiel.

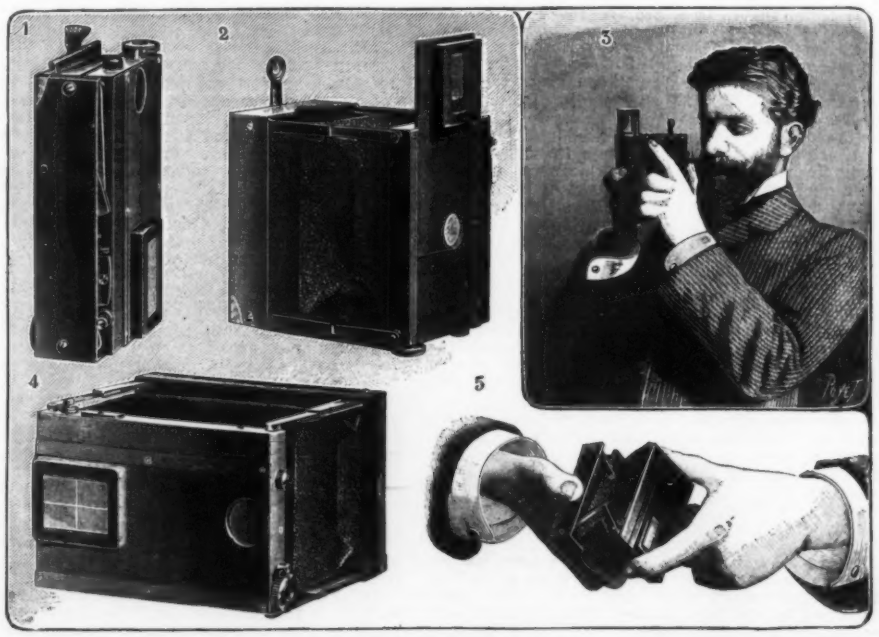
Owing to the numerous battles and heavy losses on both sides, the relative value of every ship has gone up a good deal and this squadron is already being viewed with apprehension by the Americans. Still the decisive victory in the Far East has done much to render American sea power more secure, and if the German vessels on the East Coast could only be brought into action, all serious danger would be averted. The problem is, however, a difficult one, the monitors being so far impotent, and the rival torpedo fleets merely neutralize each other.

(To be continued.)

NEW POCKET PHOTOGRAPHIC APPARATUS.

WE illustrate herewith a new pocket photographic apparatus devised by M. Gaumont, of Paris, and styled by him the "Block-Notes." The apparatus is a folding one with separate metal plate holders for 1.75 x 2.35-inch plates, and provided with a Zeiss objective and variable-speed shutter for making any length exposure desired.

The camera consists of a frame provided with a groove for inserting the plate holders, connected by a skin bellows with a board of the same size carrying the objective, shutter, and finder. The connection between these two parts, front and rear, is made by jointed rods, and the apparatus may be quickly opened or closed. When closed, it is only one inch thick. When open, it has the form of a parallelopipedon 2.5 x 3.6 x 3.2 inches in size. Its regular shape permits of easily placing it upright upon any plane surface, when it is desired to make an exposure. As the plate holders are but .118-inch in thickness, quite a large number of them can be carried in an ordinary pocket. The holders fit perfectly tight, owing to the slot for the holder being lined with velvet at the entrance. A holder can be placed in the camera, even when it is folded up, if desired; and it is held in place by a strip of metal that covers the entrance completely as soon as the slide is removed. Under such circumstances, no light can reach the plate, which may remain uncovered. The apparatus is then all ready to operate. The finder consists of a lens mounted upon a slide that permits of its being moved over the board in front. When the photographer desires to use it, he raises it as shown in Fig. 2, and in doing this automatically sets the shutter. An eyepiece mounted upon a small rod, which falls back against the rear frame, completes the finder, and, with the lens just mentioned, forms a Galileo's telescope. After an exposure has been made, the slide of the plate-holder is replaced, the holder is withdrawn, and a fresh one is introduced in place of it. Then the finder is pushed down and the apparatus folded up. All this is done in an instant. Provided with such an apparatus, the owner can go anywhere, even where photography is prohibited, and often obtain souvenirs that it would be impossible to secure without it.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT, from La Nature.



NEW POCKET CAMERA.

1. Apparatus closed and the plate frame in place. 2. Apparatus open, and the finder ready for operation. 3. Taking a picure. 4. Apparatus unfolded, showing the finder closed. 5. Mode of closing the apparatus.

THE INDUSTRIAL UTILIZATION OF SMOKE.*

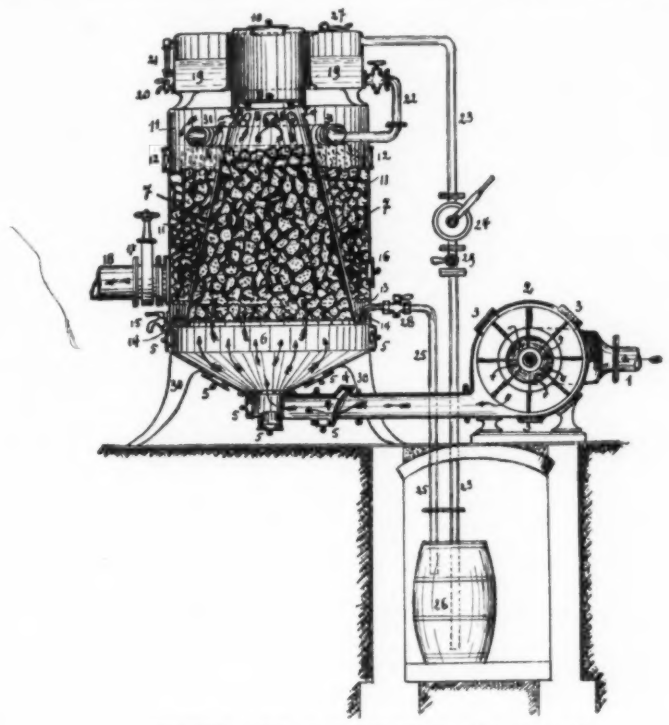
By EMILE GUARINI.

AMONG the many inventions of the day, there are few which, through their hygienic, economical, or industrial importance, call forth as keen an interest as that which attaches to the problem of the destruction of smoke. Any system which will furnish a satisfactory solution of this problem, that is to say, which is readily put into practice at a moderate cost, will be certain of general acceptance. But the interest of any such scheme is raised still further if it provides not only for the destruction of the smoke, but for its industrial exploitation.

Now this desired end seems to have been attained. On the 19th of November last, Mr. Tobiansky delivered a lecture before the Belgian Society of Engineers and Manufacturers, in which he gave an account of his system for the utilization of smoke. At the request of the president of the Polytechnic Club of the free University of Brussels, Mr. Tobiansky repeated his lecture before the members of that club on December 6, illustrating his text by many experiments.

After these lectures I paid a visit to Mr. Tobiansky, who very kindly showed me many experiments and permitted me to photograph his apparatus, and even supplied me with drawings which I asked of him for the readers of the SCIENTIFIC AMERICAN SUPPLEMENT. I am thus enabled to supply some unpublished information and illustrations.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.



FILTER AND CARBURETER FOR SMOKE.

When any combustible is burnt, there is given off a more or less visible smoke, whose essential composition varies but little. It contains in fairly constant proportions small particles of solid matter, incombustible gases (nitrogen and carbon dioxide), and combustible gases (carbon monoxide, hydrogen and hydro-carbons). This mixture is still capable of burning, as Mr. Tobiansky showed by setting fire to the smoke issuing from the tip of a paper cone lighted at its base.

But this is not sufficient for the complete destruction of the smoke, still less for its practical exploitation. In order to convert the smoke into a combustible gas, Mr. Tobiansky adopts an extremely simple method. The smoke is first filtered, then mixed with volatile hydrocarbons, thus giving a combustible gas of varying value, according to the nature of the original fuel and the mode of burning it, and also according to the naphtha used.

In his experiments Mr. Tobiansky uses a small stove in which he burns all kinds of waste material, scraps of vegetables, sawdust, rags, straw, shavings, etc. In this way a thick smoke is produced, which is aspirated by means of tread-bellows through a tower containing a porous absorbent, such as coke, soaked in naphtha or alcohol. Here the solid particles suspended in the smoke are arrested, and the smoke gases become saturated with hydro-carbon or alcohol vapors.

The smoke after this treatment issues from a jet where it burns with an absolutely odorless luminous flame, or is collected in a gasometer, from which it is fed to Welsbach burners, stove or gas engine as required. For all these purposes "pyrogas," as the inventor has named his product, answers admirably.

The inventor has not contented himself with small scale apparatus. He has constructed plants on a working scale. Of one of these our figure gives an elevation. The smoke is forced by the fan 2 into the apparatus. It ultimately issues at 18 as a rich illuminating gas, after passing through the cone 7 and the space 11. In the cone the smoke is merely filtered by the lumps of absorbent material placed therein. Similar lumps nearly fill up the space 11, but these are wetted with naphtha, which is sprinkled upon them from the annular pipe 31 connected with the tank 19 by the pipe 22. The mode of working of the apparatus is sufficiently plainly shown in the diagram and requires no further description. This installation has been put up for the production of the requisite quantity of pyrogas for a Galloway steam boiler of 40 square meters (430 square feet) heating surface. The fuel consists of rags, horse manure, sawdust, and paper.

Another practical installation was put up to furnish pyrogas for lighting a private house in Brussels with 50 Welsbach burners. In this apparatus the smoke is forced in by a blower driven by a weight of 500 kilogrammes (1,100 pounds). The pyrogas produced by this apparatus is sufficient for feeding a 12 to 15 horse power gas engine, such as might be used for working a dynamo.

Mr. Tobiansky has also worked out another system for the destruction of smoke, in which the smoke is turned, not into combustible gas, but into solid fuel. For this purpose he condenses the smoke in lumps of coke sprinkled with specially chosen hydrocarbons. When the coke is completely saturated with smoke it constitutes a rich and highly calorific fuel, for it contains, in addition to the carbon originally present, the soot and the heavy hydrocarbons collected, the hydrocarbons with which the coke is wetted originally being so chosen as to absorb the latter.

Of all the numerous applications of Mr. Tobiansky's invention, the most important from a point of view of hygiene and economy is undoubtedly the combustion and utilization of the garbage of towns. Mr. Tobiansky has drawn a design of a plant for such combustion for the city of Paris. It would certainly be worth while to give this project a trial, for none of the meth-

ods in use hitherto work satisfactorily. It has been proposed to dry-distill the rubbish, street sweepings, waste material, etc., in retorts. But that would necessitate the use of fuel, and the product would represent a dead loss. Again the direct use of rubbish as fuel has been proposed, for heating steam boilers. But in this case also the evil-smelling smoke would escape, representing a dead loss, necessitating tall chimney stacks and vitiating the atmosphere.

But Mr. Tobiansky's system would furnish the means for the combustion of such waste material and the direct recovery of the smoke produced, which would be converted into pyrogas. A few details of the plan adopted for this purpose will be of interest.

After removing the scraps and the larger pieces of combustible matter, such as pavement stones, flower pots, etc., the rubbish is turned over into an oscillating sorting sieve. Cinders and similar material are hereby separated and added to the heavier portions already removed. The light materials, such as rags, paper, cardboard, string, etc., are caught on hooks on the sorter, and are subsequently removed by inverting the sorting sieve and setting it in oscillation. A workman assists this process by means of a rake, and finally all this material is heaped up on a platform, which conveys it into a drying oven heated by means of some similar material previously dried. When the drying operation is completed, the bottom of the drying chamber is pulled out and the material falls into the grate, where it serves to furnish the heat for the drying of some further rubbish.

The smoke produced is drawn in by a ventilator through a device of the nature of the one figured and described above, and is so converted into gas for illuminating or heating purposes, without necessitating any further purification processes.

There is thus obtained a gaseous mixture possessing a calorific value of 1,300 calories per cubic meter, or 37 calories per cubic foot. The addition of 1-10 liter of naphtha produces an additional calorific value of 1,000 calories per cubic meter or 28 calories per cubic foot. (V. Witz, "Gas Engines.")

The combustion is carried on with reduced air supply. The quantity of air required varies from 4 to 5 cubic meters per kilogramme of the combustible (equal to 6.4 to 8 cubic feet per pound). Now the rubbish contains ordinarily about 50 per cent of gross incombustible matter, removed by the preliminary sorting process. One cubic meter weighs about 400 kilogrammes. If we deduct from this 75 per cent, we are left with 100 kilogrammes of combustible substances, which, burnt with a supply of 4 cubic meters of air per kilogramme, give 400 cubic meters of gas per cubic meter of rubbish. Now 1,000 inhabitants furnish one cubic meter of garbage per day; a town of 100,000 inhabitants will therefore produce 40,000 cubic meters of gas, which, carbureted in the ratio of 0.10 liter per cubic meter, require 4,000 liters of hydrocarbon. If this costs 4 cents per liter the cubic meter of pyrogas costs two-fifths of a cent. If used for driving a gas engine consuming one-half cubic meter per horse power per hour, pyrogas produces the horse power at the rate of one-fifth of a cent. If we add to this one-tenth of a cent for cost of installation and keeping in repair, the cost of the horse power does not exceed three-tenths of a cent per hour.

If this power is transformed into electric power at the rate of 500 watts per horse power per hour, the cost of a hectowatt figures out to three-fiftieths of a cent.

The installation of a plant on the above described plan requires an outlay of about $30,000, and its working would yield an annual profit of $16,000, if the general expenses amounted to $17,000 and the total receipts reckoned at one cent per cubic meter of pyrogas, were $33,000. This does not take into account any value extracted from the ashes, waste scrap metal, etc., recovered from the rubbish. The ashes for instance can be sold as such for artificial manure or for filling up or embanking; if mixed and crushed with the larger pieces of waste, they form an excellent gravel, or mixed with lime, a highly valued mortar.

The hygienic advantage of this system of annihilating smoke is obvious. The economic value is understood from the figures quoted above, and from the fact that, as Mr. Tobiansky has calculated, in Brussels the smoke produced by the combustion of rubbish of all kinds would suffice for lighting with pyrogas all the streets of the city, or it would furnish the power necessary for electric light for the whole town.

It should be added that not only can the destruction of rubbish furnish valuable energy, but also the combustion of the smoke from factories, and private houses. In order to accomplish this, the smoke must be aspirated from all fires to a central station where it is converted into pyrogas and stored in a gasometer. The gas does not undergo any condensation and therefore keeps perfectly.

It might be said that this is a great deal of trouble for the sake of a little smoke, that the game is not worth the candle, and economy outweighed by the expense. But this is leaving out of account that combustion under the most favorable conditions, that is to say, with just the requisite air supply, still results in the formation of 15 to 20 per cent of carbon dioxide and a loss of 10 per cent in the form of smoke; that with an air supply 2 or 3 times as great the percentage of carbon dioxide is about 6 or 7 and the loss in smoke 25 or 30 per cent; with 9 or 10 times that air supply (a condition common in practice) the carbon dioxide amounts to 2 or 3 per cent and the loss to 80 or 90. Thus in London, for instance, the loss of fuel amounts to about £12,000,000. Add to this the damage done by the smoke and the astonishing total of $75,000,000 is reached.

Instances of the application of Mr. Tobiansky's process might be multiplied. The reader will readily for himself realize its significance to locomotives and steamers, which will find the quantity of fuel they are compelled to carry greatly reduced, while men of war will no longer betray their position by the long trail of smoke, which under the present conditions follows them.

The great problem of the annihilation of smoke appears to be solved. Pyrogas is completely consumed, leaving as final products of combustion only carbon dioxide and water vapor. While being applicable for all those purposes for which coal gas is used, it has the advantage of being cheaper and of excluding every trace of smoke from the atmosphere. If this system is put into practice, the smoke of fires, instead of poisoning the atmosphere, as it does now, will be converted into motive power, light, heat or electric energy for private or public use.

In conclusion, we note that several large factories in Belgium have already adopted Mr. Tobiansky's system on trial.

PHOTOGRAPHY AS APPLIED TO ILLUSTRATION AND PRINTING.—I.

By J. D. GEDDES.

THE object of this and the following lectures will be to explain generally, and, as far as possible demonstrate, the means and methods at present employed in the production of illustrations by photographic processes for the printing press.

It is not expected, and I do not propose to give you, close technical details or exact formulæ of the working. Those dry bones of my subject may be ascertained by those who wish it from the numerous text-books, dealing with every branch of photo-mechanical illustration, or special information may be obtained in a practical form by attending the admirable lectures given by the technological classes organized by the Polytechnic Institutions and London County Council. I shall therefore, to the best of my ability, endeavor to describe in simple language the general principles of the various processes, and by means of the lantern and of examples, demonstrate how the results are obtained.

If there happen to be any gentlemen present who are specialists, hoping and expecting to be instructed and enlightened in the particular working of one or other of the processes, I can only say that as far as these gentlemen are concerned, I humbly apologize for appearing before them, for I am about to talk to my uninitiated friends, and try to tell them what is going on in the world of Process Illustration.

The present methods generally employed in the production of printing press illustrations by photography may be epitomized as follows:

Photo-lithography.

Type Block.—Reproductions from Line Drawings.

Type Block.—Reproductions from Wash Drawings and Photographs.

Photogravure. Rembrandt Photogravure.

Collotype.

Woodburytype.

Type Block.—Reproductions by the Three-Color Process.

There are many other photo-mechanical processes in existence, but to describe them all would occupy much more time than the limits of these lectures permit; it will therefore be necessary to deal only with the typical processes I have named. They are in one way or other allied to all known photo-mechanical methods of producing illustrations by means of the printing press; and while they cover the scope of my subject, such details as I can give you about them will no doubt also more than absorb the time at our disposal.

Photo-lithography is named first, because it is, I believe, one of the earliest, if not the earliest practical application of photography to modern illustration by the printing press (I am excepting Fox Talbot's photo-intaglio process for the moment).

I hope I am right in assuming that you all know generally about photographic negatives and positives, and that you are aware there are several different kinds of negatives and positives employed in the making of blocks and printing surfaces in photo-mechanical processes; those that are necessary will be described in their place. I may say now that the old (1857) collodion process of negative making still holds its own for process work against the more modern dry plates, though there are several successful process workers now using only gelatino-bromide dry plates for their productions. The first thing necessary for a photo-lithograph is a good clean sharp negative of the subject which is to be reproduced. This negative may be made of collodion or gelatine, but it is necessary that the negative should be what is termed *dense* in the parts representing the whites, and that the lines should be clear glass. Generally speaking, photo-lithography is only employed for reproductions of line subjects, such as maps, plans, and architectural drawings, though there are modifications of the process for tone work, which I will mention later.

Now I must describe to you a principle which is the foundation of nearly every photo-mechanical process, viz., the action of salts of chromium in combination with organic substances. If a solution of gelatine in water charged with a small percentage of bichromate of potash, is spread on paper and dried in the dark, and then exposed to light, it will be found that the gelatine surface has lost its solubility, and has acquired a new property, that is to say, it will no longer absorb water and dissolve, but will remain permanently hard, horny and insoluble. This curious light action was discovered as long ago as 1839, by Mungo Ponton, and it is to-day the basis of a whole range of beautiful processes of illustration comprising carbon printing, photo-lithography, photogravure, photo-etching, and engraving, Woodburytype, collotype, etc.

Organic substances of the nature of gelatine, gum, starch, fish glue, isinglass, dextrine, etc., are all affected in the same way when treated with any of the bichromates, and the varied use of these substances often constitutes the difference between one process and another.

To return to the subject of photo-lithography, here is a sheet of gelatined paper not treated with bichromate, and it can be exposed to light indefinitely without altering its nature. This sheet has been soaked for a few minutes in a 3 per cent solution of bichromate of potassium in water, and dried. The light seems to act in two definite ways on bichromated gelatine: 1st, by rendering it insoluble; 2d, by causing it to lose its property of absorbing water, or swelling. This sheet of gelatine has been exposed to light under this negative for a few minutes, and if examined closely you will observe a faint brownish tinted image of the lines of the negative. Now another curious property of this oxidized gelatine is taken advantage of. I have said that it refuses to take up water; conversely, if it refuses water, it will admit of being greased or inked, and if a roller, charged with printing ink, is passed over the surface of the gelatinized paper while it is in a dry state, the ink will "take" all over the paper, but immediately the sheet is dipped in water the ink is loosed or repelled from the soluble portions, and adheres only to the parts where the light has acted and rendered the gelatine insoluble. The sheet now shown indicates the effect of the treatment described; the lines represented by the clear portions of the negative, through which the light has penetrated, retain the ink, while the dark or shaded portions of the negative are soluble, and refuse to retain any of the ink, at once giving a positive reproduction in *ink* of the lines of the drawing.

The inked-up photographic print of the lines of the drawing now shown to you is technically known by the name of a photo-lithographic transfer, because it is used for the purpose of transferring the ink on its surface to a lithographic stone or a sheet of zinc, from which base it is printed from in the ordinary lithographic printing press, and any number of copies reproduced. I think I need not describe lithographic printing further than to state that the principal substance used for this purpose of a printing surface is a porous limestone known as Solenhofen slate: the surface of this stone is polished smooth and level, and it possesses the property of greedily absorbing both greasy ink and water; if a drawing is made upon it with an ink composed of grease and lampblack dissolved in soap, the grease sinks into the stone, and each line of a design so drawn forms a permanent printing surface which, if the stone is damp, will take ink from a roller charged with printing ink and give it up again to a sheet of paper pressed in contact with the face of the stone. To prevent the ink "taking" all over the stone when using the roller, the stone is damped with water between each impression. The stone absorbs water everywhere except where the inked lines occur, which, being greased, naturally repel water, the simple principle being that a lithographic stone accepts ink and ink only where there is already ink, and water only where there is no ink. Zinc and aluminium plates are used instead of lithographic stone for printing from, and they are treated and used in precisely the same way as the stones; these metal sheets have the advantage of being lighter, cheaper, and easier to store and handle.

You will observe that we have only spoken up to the present of the reproduction of designs drawn in line, but within the last ten or twelve years considerable numbers of excellent illustrations have been produced by this process of drawings, which are in monochrome, and of photographs. The difficulty which occurs in dealing with reproduction of subjects which are represented by continuous graduated shades from black to white is, that there is no known printing surface or ink (excepting, perhaps, Woodburytype) which will distinguish any intermediate tone between black and white, in fact the printing press is only capable of rendering two shades, viz., black and white. This difficulty has, however, been practically overcome, and it is now quite possible to produce the graduated shades of a photograph for instance, though the gradations are not homogeneous, but are subdivided into granulations or grains, arranged close together for the deeper shades, and separating or becoming finer for the lighter tones, giving to the eye the effect of unbroken shades, though they are really not so. I shall have to speak of this in dealing with half-tone negatives for block printing a little later; at present photo-lithography is before us, and the problem of reproducing half-tones by that process. Many methods have been devised for breaking up the gradations into lines, stipple, or dots, and much ingenuity was exercised by the earlier experimentalists to produce the effect of half-tone photo-lithography. The names of Dallas, Pretsch, Bolas, Waterhouse, Ives, and Husband are landmarks in its history. The idea throughout was the production of a grain or texture which would be to some extent discriminating, that is to say, form automatically groups of large, close grains in the deepest shadow, graduating into finer and finer grains until the lightest tints were reached. It was found that the addition of a hygroscopic salt, like calcium chloride, to the ordinary gelatine and bichromate coating for the lithographic transfer, had the effect of breaking up the texture of the gelatine image, and permitted of a transfer being made of monochromes or photographs. The process has been further developed by Messrs. Sprague & Co., who employ a method analogous to collotype for obtaining their transfers. The results of the process in their hands are very successful, and are largely used for commercial and artistic illustration. Photo-lithography generally is an important process, and it is employed for the rapid production of plans, maps, machine drawings, *fac simile* reproductions of manuscript, and notably in the Ordnance Survey Department at Southampton.

BLOCK REPRODUCTIONS OF LINE DRAWINGS.

The next important process in order of seniority and usefulness is the line block process on zinc, and it is curious in regard to it that the present methods of working are almost identical with those adopted by the original inventors. Another singular point is that the medium for sensitizing the metal plate which to-day gives the finest results, namely, bitumen, is the substance which M. Nicephore Niepce discovered in 1827 as being sensitive to light, and he submitted photographed images on a plate coated with a film of bitumen, to the Royal Society of this country in the year named. The process has now been in use for the past 30 years or more, and the principles of photo-lithography just described to you largely enter into the working of the line block process.

The first requisite for the production of a good result is a suitable original; the drawing should be made with perfectly black lines throughout, it is of no consequence how thin the lines are, but they must be black; it is important too that the scale of reduction should not be too great; the best proportion is for

the drawings to be made about one-third larger than the required block. The paper used for the drawing should be white and smooth in texture.

The negative for a line block is made preferably by the wet plate or collodion process, because of the facility with which these plates can be intensified, and the clearness of the lines; the negatives for this process must be reversed, so that the resulting picture may be non-reversed, which result can be obtained in two ways, first, by photographing through a prism or mirror attached to the lens, or second, by stripping the film, carrying the image off the glass, and turning it.

The reversed negative is next printed on the metal which is to form the block in the following manner: A piece of polished and perfectly flat zinc is cut to the proper size, and freshly polished in water until it is free from all traces of grease; it is then sensitized by either flowing over it a solution of asphalt in benzol, or, as is more generally used because of its rapidity, a solution composed of egg albumen, water, and bichromate of ammonia; an even film of this solution is floated over the metal, and is dried by gentle heat; as soon as it is dry it is sensitive to light, and is at once placed in a printing frame over the negative; a few minutes' exposure to daylight, magnesium, or electric light, is sufficient to oxidize the albumen where the light has obtained access to it through the lines of the negative; the plate is then covered all over with a thin coating of ink from a printer's roller charged with ink to which a little turpentine is added, and is then dropped into a flat dish containing cold water; the inky surface of the plate is then gently rubbed with a pledget of cotton wool, and the ink coating, together with the unused albumen, leave the plate together, except in the places where the light has acted through the negative and rendered it insoluble, the result being an image of the subject photographed on the metal, covered with a greasy, acid-resisting ink; in this state the plate is ready for the first stage of the etching process, that is to etch or bite away with acid all the metal surrounding the lines and render the picture in high relief, so that it may be printed in a printing press in the same way as type. The etching of such a plate is the simplest thing possible in the abstract, but a considerable amount of skill and experience is required to carry the etching to a successful issue.

The theory is that a metal like zinc is quickly dissolved or etched by nitric or hydrochloric acid, so long as there is no grease or varnish on the metal to interfere with the dissolving action of the acid; that is so, but in the case of the plate we have to deal with a very thin protective coating, and with lines which are so narrow that they might be represented as knife ridges. There is also an element to be reckoned with in the fact that the acid not only etches downward, but sideways. It is therefore necessary to proceed with some caution, and the first etching is performed for a few seconds only in a very weak acid, just strong enough to taste acid, after this the lines are slightly re-inked with a roller, and while the ink is wet, it is dusted with powdered asphalt or rosin, and afterward heated to melt the powder into the ink. The etching proper is then proceeded with, and occupies two to five hours, but it is by no means a straightforward operation. For a time, every few minutes the plate is taken out of the acid bath, and further strengthened with ink and rosin, and as the etching proceeds, the piled-up ink on the lines is heated and melted, so that it runs down the sides of the lines to protect them from being undermined by the acid; when a sufficient depth is attained to make the lines high enough to ink sharp and clean in the printing press, the whole of the etching ink is removed, and the tops only of the lines carefully re-inked. A finishing etching is then given to remove the shoulder and steps on the sides of the lines caused by the various inkings and meltings. When finished, a properly etched plate should have each line firmly and cleanly cut, and be supported by a pyramidal-shaped base. The plate is now ready to be trimmed and mounted on wood type-high for the printing press.

REPRODUCTIONS OF WASH DRAWINGS AND PHOTOGRAPHS.

Save as regards line blocks, until early in the '80's, it can be said that there was no process in existence by which paintings, wash drawings, or photographs could be "processed," to use a bad term, into the form of a surface printing block for the press, and the introduction then of the half-tone block marked an epoch in the history of photographic illustration which has done more to revolutionize the making of pictures than almost all the other processes put together. The origin of the process cannot be definitely claimed by any particular investigator. Its development was the result of a kind of evolution of Bullock's process of 1866. Meisenbach, of Munich, patented a half-tone process in 1882. Mr. Ives, of Philadelphia, Mr. W. B. Woodbury, and others were experimenting and publishing results in rapid succession, until within a period of a very few years the process as it now exists was practically established. I recollect very clearly the "dark ages" of the half-tone process, when all kinds of expedients were adopted to break up the gradations of a photograph into lines or dots by the interposition of a texture of silk or fine linen; also the days of wire gauze, ruled lines on paper, and other similar processes. The Americans were first in the field with an improved device for breaking up the image into dots, which was so much superior to anything invented in Europe that almost every other method was dropped in its favor. I refer to the diamond ruled screens made by Mr. Max Levy, of Philadelphia. These screens or gratings are so essential to a description of the half-tone process that I will occupy a few minutes of your time in telling you how they are made. A sheet of the finest plate glass is selected and is coated with a varnish composed of asphalt and wax. The coated glass is placed on the bed of an automatic ruling machine of extremely accurate construction and capable of ruling lines of any degree of fineness up to 500 to the inch; the cutter of the machine is diamond pointed and gaged to cut lines of any desired width. The lines are ruled diagonally at 45 deg. across the glass, and the number to the inch varies according to the kind of work for which the screen is required; for newspaper printing the lines may be 50 or 60 to the inch, for commercial and catalogue printing 100 to 130, and for finer magazine or book illustration 150 to 200 to the inch. When the ruling of the glass is completed the ruled surface is subjected to the action of the hydrofluoric acid, which eats into or etches the lines laid bare by the diamond and forms a channel which is filled up with an opaque pigment. This enamel is baked in the lines in an oven, and then the surface is carefully polished until the lines are perfectly level and the spaces represented by the clear glass are bright and transparent. Two of these ruled glasses are required for each screen, laid together with the lines crossing at right angles and cemented with Canada balsam. As may be imagined the screen gratings are somewhat expensive; a piece measuring 12 inches by 10 inches of 175 lines costs about £25, while large screens of 24 by 18 are charged at £100 or more. I am glad to state that we have now an English firm (Messrs. J. E. Johnson & Co.) who rule these screens excellently, indeed there is little to choose between this work and the best American, which is a comforting thing to say in these days when it is a habit of the ever-present pessimist to decry everything that is English and all that the Britisher does.

To produce a half-tone block from a picture, wash drawing, or photograph, this ruled grating is placed in front of the sensitive plate, but not in contact with it. The screen *distance* from the sensitive plate is a point of importance in making the negative, and the skillful operator has to determine this distance according to his experience, and to the character of the subject which is to be photographed. If it is placed too close the resulting negative will present what is known as a grid-iron appearance; if it is too far away, the dotting will be too close in the lights, and too small in the shadows. You will understand how necessary it is to keep a nice balance in this matter in the case of a picture which is built up entirely of an infinity of dots, shadows being represented by grouping of dots close together, with smallest of spaces between middle and light tones, by dots of different gradations in size, and the highest lights of pin point dots only. Everything is represented by dots, yet they are so accurately graded in relation to the light and shade of the original, that the eye does not detect them, unless examined closely, and the half-tone picture appears as a practical *fac simile* of the original from which it was photographed.

The method of printing half-tone negatives on metal is similar in most respects to that described for line blocks on zinc, with this difference, that most half-tone blocks are now etched on copper, and the sensitizing solution generally employed for this metal is a compound of fish glue, albumen, chromic acid, water, and bichromate of ammonia. The copper is carefully cleaned with Tripoli powder and washed, the sensitizing solution is then flowed over it twice or three times and placed on a revolving table, where it is rapidly whirled, in order to spread the coating thinly and evenly over the whole surface; the coating is then dried by gentle heat in a yellow-lighted room, and the plate is now ready for exposure under the half-tone negative; three to ten minutes' exposure to an electric arc light completes the printing, when the plate is removed to a bath containing cold water, and soaked and washed under a spray of water until the unacted upon compound is dissolved out, an operation occupying five or six minutes. The image on the metal at this stage is almost invisible. In order to enable an examination of the film to be made, the plate is dipped into a solution of methyl violet, which dye immediately stains the film, and brings the picture into view. If all has gone well, the surface is dried either by flowing it with methylated alcohol or gentle heat. The next operation has an important effect, namely, a hardening of the delicate glue picture into a substance resembling enamel, and this gives the method its name—the enameline process. The plate is simply heated to a high temperature over the flame of a large Bunsen burner; during the progress of this "burning in" or enameling, the image changes curiously; the blue picture gets pale, then gray, and eventually vanishes entirely; after a few seconds, as the plate gets hotter, the image appears as a faint brown, and gradually increases in strength until it fully attains a rich chestnut brown tint, when the heat must be withdrawn, and the plate is cooled off. The plate has now a picture fixed upon it, which is formed of a strong, hard, impermeable coating of enamel, and which will bear any reasonable amount of etching without further protection. The etching bath is made up of neutral perchloride of iron dissolved in water, and of a strength which registers 35 deg. with a Baumé's hydrometer. The plate is first subjected to a general etching all over the plate sufficient to give the block a printing depth; that is, to etch away the spaces round the dots forming the picture so that the plate may be inked over with a printer's roller charged with ink, and a first proof of the photo-etched picture pulled in the press. In most plates made by this process a further and local etching must be performed. The dulling of the general effect caused by the interposition of the necessary screen grating has to be removed as far as possible, and this is done by artists who are specially trained for the work. The parts of the picture which are in shadow and are usually correctly rendered by a properly exposed negative, are covered over with varnish and the next tones are etched again, then these tones are covered up and the high lights are treated until the resulting picture, when proofed, correctly represents the original. The plates are then trimmed by engravers, beveled to admit of being riveted to the wood mounts, and are mounted type-high for use in the printing press.

Many efforts have been made during all the years these mechanically grained blocks have been in use to find a means of producing a printing surface which would give a pleasing result with an irregular grain like that given by collotype or photogravure, but the results so far have been disappointing; perhaps some of this disappointment may be due to the fact that the eye has been trained by years of use to look for and expect the smooth, clean results given by the mechanical ruled screen, and that any other result, though it may in a measure be more artistic, is not acceptable. I would like to mention, however, in closing this lecture, that Mr. Wheeler, of Bushey, has introduced a new screen for half-tone work. This promises much in the direction of the making of pictures which are free from mechanical effect, and are yet sufficiently delicate in texture to retain the finer details. His screens have no pigment in the graining; they are formed by a delicate etching of the surface, which leaves the plate very transparent, and the breaking up of the image to form the printing surface appears to be formed by causing the surface of the screen to act as if it were made up of an infinity of lenses. Some examples of this process will be shown to you, and will be found extremely interesting.—Journal of the Society of Arts.

(To be continued.)

CHAMOIS SKINS.

By CHARLES C. DRUEDING.

IN presenting this article the writer will endeavor to place before you a plain, intelligent treatise on this subject, as he understands it from his experience of manufacture, or tanning rather, during an experience of about eighteen years.

The name chamois skin is rather a misnomer; it originates from the chamois animal, the zoological name being Rupricapra targus. This animal inhabits the European Alps and Caucasian Mountains and resembles a goat or deer. These animals are very shy, and hunters will follow them for days over dangerous mountain passes until they finally bring their prey at bay.

The animal is about the size of a goat or deer; of a dark chestnut-brown color, with the exception of the forehead, the sides of the lower joints and the muzzle, which are white. Its horns, rising above the eyes, are black, smooth and straight for two-thirds of their length, when they suddenly curve backward. The hoofs of the animal are admirably adapted to avail themselves of little roughnesses or projections on the mountain sides, or icy glaciers. It has long, thick and coarse hair.

What is known in the market as chamois skin is really an oil-tanned sheep or lamb skin lining. The supply of skins from the chamois animal is very limited; enough could not be obtained in a year to supply the United States for more than a single day.

The writer made special inquiry on a recent visit to Switzerland about the annual crop of this class of skins. From all that he could learn, about five thousand to six thousand skins would be a fair average yearly crop.

This skin is heavier than the skin of the sheep or lamb, also much coarser. For strength and durability this skin is preferable, but for ordinary use and appearance the oil-tanned sheep skin lining would, in most instances, be preferred.

To manufacture sheep or lamb skins into chamois leather the first step necessary is to remove the wool, which is accomplished either by painting the skin on the inside with a solution of sodium sulphide or by immersion in milk of lime.

By the former method the wool is loosened in a few hours; by the latter method it will require several days. When the wool is loose, it is pulled off either by hand or scraped off with a dull instrument.

The skin is now again immersed in milk of lime, to swell it. It is then cleaned (beamed, as the trade calls it), to remove all fleshy particles that may adhere to it.

It is now ready for splitting. I wish to explain here that chamois skin is really only the half of a skin. The outside, that is, that part of the skin next to the wool, known as the grain side, is not suitable for chamois leather, and is used for other purposes, mostly for hat linings, book covers, etc.

In former times, when skins were prepared for oil tannage, this part of the skin was cut away with a suitable knife and thus lost. In our days the skin is cut through the center (split), thus producing two skins from one—the outside, called grain or skiver, and the inside, called lining or flesher.

The splitting is accomplished on machines specially constructed for this purpose. It consists of an endless knife, the edge of which is constantly grinding to keep it sharp, the skin being passed through rollers against the sharp edge of the knife. These machines require very delicate adjustment to produce good results.

The lining or flesher is now ready for tanning. This is accomplished by sprinkling it with oil, codfish oil of good quality. It is important that this oil should be thoroughly incorporated into the skin. For this purpose a quantity of the skins are placed into what are known as fulling stocks, which twist and turn the skins in every direction, and distribute the oil evenly.

After sufficient milling the skins are partly dried and the process of sprinkling and drying is repeated again and again until they are full of oil, and all the moisture is dried out. They are now allowed to hang sufficiently long to thoroughly tan them at a temperature of about 100 degrees.

The process after this is very simple. The oil is removed by pressure, and the balance washed out by saponification; after this they are dried and they are then ready for finishing.

The oil, by the way, is recovered, by decomposing the soap solution with an acid and separating. It is sold to manufacturers of other leather, it being useful to make them pliable, etc.

The finishing is done mostly by pressing the skin against revolving wheels, covered with emery or flint to remove all adhering substances and to present a finished surface.

We now have the finished chamois leather ready for the trimming and sorting room, where it is cut into suitable sizes and packed for the market.

Of late years, a trimmed skin, that is, skins of even sizes, are preferred by the trade. For this reason most manufacturers, at least most American manufacturers, cut their skins over patterns so as to produce uniform sizes. In former years, when England and France supplied the United States market, the skins in the same package would vary in size and shape, thus lacking uniformity.

It is true by cutting uniform sizes there is necessar-

ily some waste, but this is reduced to a minimum, when all small pieces are again utilized, by manufacturing them into watch pockets and other small articles which find a ready sale.

The principal uses for chamois skins are for cleaning purposes. They absorb moisture readily and give a high polish to glass, furniture and other highly polished surfaces.

A good chamois can be used either wet or dry. Quantities are also used for chest protectors, chamois vests, and even underclothes are made out of them for cold climates, also in the manufacture of other leather goods, such as purses, etc. Ladies use them for fancy work.

They can be made in all colors; formerly colors were mostly produced by applying to the surface of the skin different colored pigments which adhere to the leather. This produces an unsatisfactory article, however, as it will always dust more or less. Of late, however, manufacturers have succeeded in producing fine colors with aniline, which are more satisfactory.

By incorporating a small quantity of ferric oxide, very finely powdered, an excellent polishing chamois is produced for silverware, etc.

A good quality of chamois skin is generally of a yellow or light yellow color, which, when freshly cut, should show a dark yellow color. This is a characteristic test of oil tannage. The absence of this color is generally an indication that the skin is tanned by a different method.

A good quality of oil leather should also absorb moisture readily. This test is readily applied by dropping a few drops of water on the skin; it should absorb it readily. If these drops roll about on the skin without absorption, it is almost a sure indication that it is not oil-tanned.

For some purposes a very light straw-colored chamois is demanded by the trade. These are produced by bleaching with sulphur. The skins, slightly damp, are hung in an air-tight room in which a small quantity of sulphur is burned, producing a light straw-colored product of bright color. It rather weakens the skin, however, and also incorporates some sulphur, which is objectionable when used in connection with silverware.

These bleached goods should not be used for wrapping silver, as they are apt to tarnish it by producing sulphide.

The market affords a number of different brands of chamois skins. The principal ones are the American goods, the English and French goods.

The American goods of late years have largely crowded out the imported goods, and are even now getting quite a foothold in Europe. Large quantities are now being exported principally to Germany, where they find a ready market. The English goods are generally of good quality and tannage. They come in both colors, yellow and white, the latter color being produced by bleaching.

They are trimmed and sorted mostly in irregular shapes and sizes; the French goods mostly of a dark yellow color, in large sizes. One variety, Bruts, are heavy skins finished on one side only. This is purposely done, so that they absorb large quantities of water, thus making them suitable for stable work, carriage washing, etc. Another variety of French goods is the double dressed. These also come in large sizes only. They are very similar to the Bruts, with the difference that they are finished on both sides, making them thin like ordinary goods.

Another variety produced by American makers is what is known as steel-colored goods. These are not oil-tanned goods. They are chrome leather, produced by tanning with chrome. This produces a bluish-gray colored leather. They are very strong, and for this reason will bear more abuse than the oil-tanned goods. They may be washed with nearly boiling water without much danger of injuring them. These are preferred by some for this reason. Some are also sold on account of color for fancy work, etc.

Most manufacturers sort these skins into three qualities—first quality, second quality, and third quality—and prices are regulated accordingly. The first quality should be almost free from stitches, soft and nearly perfect. The second quality are rejects from the first on account of too much stitching, harsh spots and other imperfections. The third quality are again rejects from the second quality.

The drug trade, for the sake of retaining the public opinion that only the best quality of everything is obtainable in a drug store, should handle only the first quality of goods.

Chamois skins are largely sold by the drug trade. Spring and fall are the best seasons to display them in the stores. A very attractive window display can be made with these goods.

Care should be taken, however, when used for this purpose, not to expose to sunlight, as this will very quickly bleach them, and thus render them unsightly. This does not deteriorate the quality in any other way, however.

A glass case filled with the goods, placed so that they can be seen, will keep them clean, and help to remind a woman when she enters the store that a chamois is needed in her household, and will assist materially to help sell the goods. Some druggists will keep them hidden in boxes or drawers, and produce them only when called for, with the inevitable result that their sales will be very limited.

A good quality chamois skin if properly used should last a long time, and they can, of course, be used wet as well as dry. It is important that it is kept clean. If it is soiled, the best method of cleaning is by washing with soap and water. A liberal supply of soap is always beneficial to the skin.

The best method to prevent shrinking is to rinse it in soap suds before drying. When dry, rubbing and stretching will return it to its former softness.—American Journal of Pharmacy.

HAVEMEYER ON THE SUGAR MARGIN.

CONSIDERING in the Century the relations of the alleged over-capitalization of the sugar trust to prices, Mr. Franklin Clarkin has this to report of Mr. Havemeyer's claim that he has reduced the sugar margin:

It is somewhat essential to know whether the consumer is paying more for his sugar than he ought. No doubt the trust has brought economies to bear which have made refining cheaper than under the old system, for it is still able to pay seven and twelve per cent on stock which has been highly "watered." By listening to Mr. Havemeyer one may come to some practical conclusions. He volunteered one day:

"When any one asks me what I have done to be proud of, I tell him just this: 'I have decreased the margin on sugar.'"

That is certainly of record; the stated margin of profit, or the difference between the cost of the raw and the price of the finished product, has been reduced by the sugar trust's operations, according to the sugar statisticians. There are sugar men who will be inclined to dispute Mr. Havemeyer's claim of achievement.

The average margin shows considerably lower than before the trust, and lower even than the average of the four years in the course of which refineries were going into bankruptcy. Benefits arising from the economies of the combination were not, to be sure, distributed equally among public and workmen and stockholders. That would be going beyond the custom of our times. The people were not mulcted (a word Mr. Havemeyer uses often) and the workmen were not mulcted; each received some good.

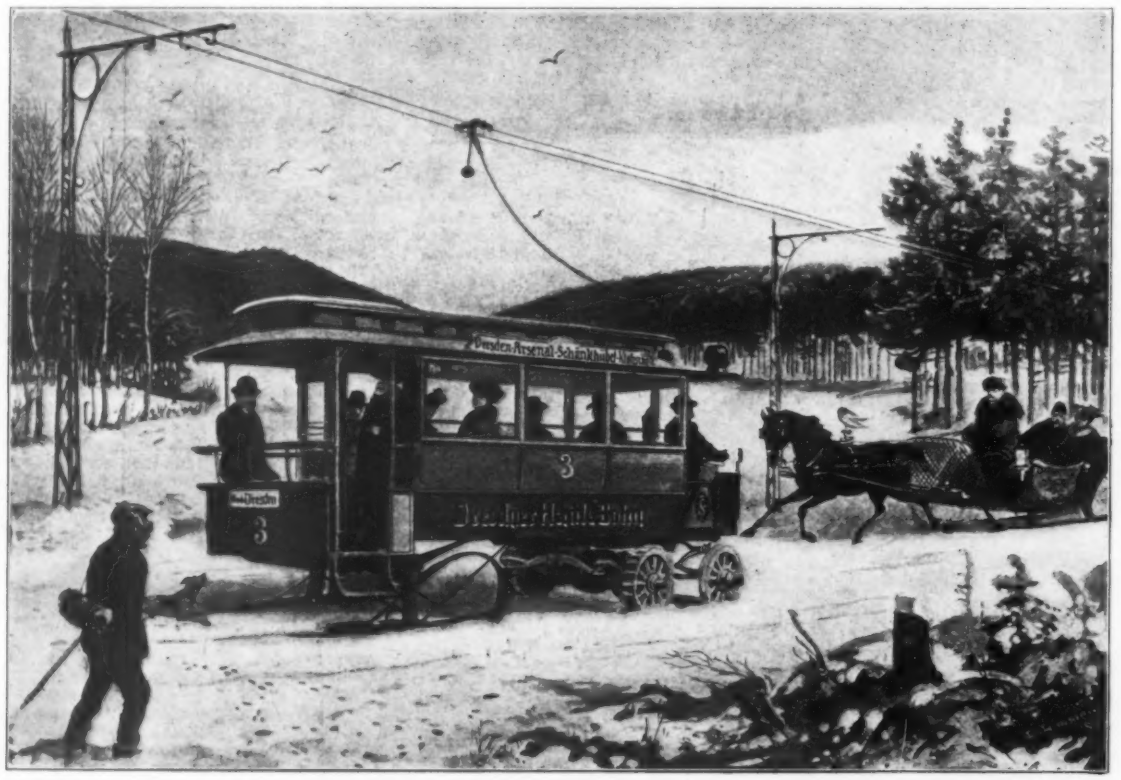
Whether the reduced margin is due to any outflow of kindness from Mr. Havemeyer, or his ambition to "refine the sugar of the American people," one need not speculate. He says quite frankly:

"Business is not philanthropy. I think it fair to get out of the consumer all you can, consistent with the business proposition. But if you ask too much of a profit, you get somebody into competition. The only way to reduce competition is to keep your prices below the competitive point. We try to make our prices so low as to defy competition—the real motive being the protection of our own business, the result being no profit to rivals."

TROLLEY SLED CAR.

THE cost of the network of rails constitutes an important item in the installation of a trolley line. Therefore the idea to cheapen the construction of such roads by leaving out the rail system is not new, and applicable especially where it is desired to give small towns and rural districts with rising industries the benefits of this means of conveyance. Such lines without rails and with overhead wires have already been constructed in various places.

Our illustration shows a car of the trolley line between the Dresden Arsenal to Schönkhübel-Klotzsche-Königswald, built by Carl Stoll after his own system. A special peculiarity of this car is that it is equipped with three axles; by reason of the distribution of the load effected thereby, the axle pressure is considerably lessened. The current is conducted to the starting motor through a little carriage running on two overhead wires, which is safely guided by a suspended weight. This trolley is connected with the motor car by a flexible cable, which is quite long in order to secure for a car sufficient freedom of motion for turning aside and overtaking other vehicles. The passing of two motor cars meeting each other is readily accomplished by the motormen exchanging the supply cables which are attached to the car by means of plug-contacts. The cars can then proceed at once.



SLED CAR ON A TRACKLESS TROLLEY ROAD.

The great adaptability of the motor frame for various purposes is quite interesting. The omnibus shown in the picture can be easily taken off and a freight car or a landau body put in its place. In winter the wheels on the starting axle are provided with ice-tires. The large rear car wheels can be removed and replaced with sleigh-runners. Hence the frequently expressed opinion that railless lines cannot be run in winter is now evidently disproved.—Translated from Illustrirte Zeitung for the SCIENTIFIC AMERICAN SUPPLEMENT.

MAKING CASTOR OIL.

CASTOR oil is made principally in California, Italy, Mexico and India, but most extensively in California.

There are two distinct processes of extracting the oil from the seed, i. e., expression and decoction. While the latter process is adopted in Italy and India, the Californian manufacturers, and most of the Mexican manufacturers, obtain the oil in the following manner:

After gathering the seed in the fall of the year, they are placed in drying furnaces for an hour or so, for a sufficient time to soften the seeds, as the greater percentage of the oil contained in a seed can be obtained when the seed is soft. After they have been removed from the dryer, they are placed in the press, similar to a cider press, and the seeds are crushed. The oil runs into a large bowl directly beneath this press and is mixed with about an equal portion of water and boiled for one and one-half or two hours—thus precipitating the albumen and other impurities. When cool, there will be a thin scum on top, which is skimmed off. The water and oil are then separated, sometimes by running the water off and sometimes by "baling" out the oil, which is placed in the "sun tanks" (tanks of metal

exposed to the sun), where it bleaches for eight or ten hours, and is then removed to the store-room, where it is placed in barrels, carboys, etc., ready for the market. Some of the trees in California reach a height of 50 feet, and the seeds from one tree contain as much as 15 gallons of pure oil.

In more northern latitudes the castor oil plant rarely grows higher than three feet, and is used for ornamental purposes, while in warmer countries it becomes a tree.—Porto Rico Trade.

TEA IN CEYLON.

THE island of Ceylon, which for many years was one of the greatest coffee producers in the world, had all its plantations ravaged by the *Hemileïa vastatrix* in 1878; and the planters, powerless to arrest the scourge, gave up the cultivation of the coffee tree forever and substituted for it that of the tea plant. The results obtained in the Indies in the second half of the last century were most encouraging, and it would seem as if the exceptional climate of Ceylon must be wonderfully adapted to such culture. The first experiments were crowned with such success that immense tea plantations were rapidly created and a large amount of capital (about $175,000,000) was invested in the enterprise.

The English, who are great lovers of tea, and who had previously been dependent upon China for the greater part of their consumption, understood how important it was to supply themselves from their own colonies and allow their colonials to profit by the huge sum of money that was annually put by them into the hands of the Chinese producers.

Wishing to wage a desperate war with the latter, they began by organizing themselves as perfectly as possible.

In China, the tea fields are of small extent, and, since no feeling of association exists, and routine dominates everything, the processes of culture and preparation of tea are still of the most primitive character, and have hardly changed for centuries. The English, on the contrary, established in Ceylon extensive tea fields on which were used all improvements possible. But the most interesting thing was the complete transformation of the processes of preparing the leaves, and the substitution of very ingenious machinery for the primitive methods used in China, thus diminishing expenses and increasing the production. Hence all the operations formerly performed by hand became mechanical.

In describing some of the ingenious machines, we shall give the method of preparing Ceylon tea, which, for the last two years, has been sold also in France, although the preference of the consumers of that country seems to remain with the Chinese product, the quality of which is much superior.

The tea plant, which is more vigorous on the plains than upon the highlands, has leaves that become smaller in proportion as the altitude is greater, but, since the quality is in inverse proportion to the size, the most aromatic and finest teas are derived from plants growing at the highest altitudes.

The plant begins to produce utilizable leaves three years after it has been planted. The gathering is done all the year round. The laborers, principally women and children, go through the tea fields every eight or ten days, and pluck the leaves that are good. The daily crop gathered by the laborer varies from 6½ to 8¾ pounds from young plants, to from 15 to 17 from those seven or eight years of age.

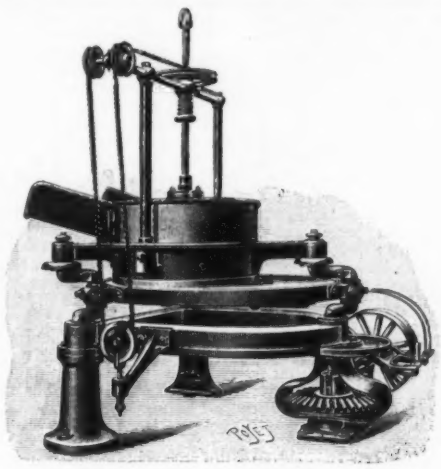


FIG. 1.—MACHINE FOR ROLLING TEA LEAVES.

Labor is very cheap, and the cost of gathering is but about three-fourths of a cent per pound of leaves. Four and a half pounds of green leaves will produce about one pound of manufactured tea. One plantation is capable of annually furnishing from 800 to 1,000 pounds of tea to the acre, and, since certain plantations embrace several thousand acres, it will be seen how large the quantity of leaves is that has to be treated in the large factories.

The first operation after gathering is "wilting"—a slight drying necessary for facilitating the rolling. This is done in large lofts arranged in most cases above the machinery hall, and which have to be well aired and lighted by numerous windows. Besides these ventilators are often employed for introducing warm air derived from the stoves.

The leaves are spread out in thin layers upon superposed and slightly inclined canvas or wooden trays. The operation lasts from 20 to 25 hours, according to the humidity of the atmosphere. The leaves become slightly sticky and very flexible, and assume a brown color. They are then allowed to fall upon the floor, and, through apertures formed here and there in the latter, as well as through canvas chutes, are sent to the mechanical rollers located in the lower story.

These rollers are of several types, but their principle is in all cases about the same. Above a bed having a circular motion is arranged a bottomless box which also has a circular motion, but in a contrary direction. The wilted leaves are introduced by a lateral hopper into the box, which gives them a continuously retarded motion at the lower part as a consequence of the displacement of the bed plate. The leaves are, in addition, pressed by a piece arranged at the upper part of the machine. As the mass is constantly turned over, the leaves are rolled isolatedly. At the end of half an hour, an orifice in the bed is opened, and the leaves, impregnated with an acid and viscid liquid, are collected in a basket. They are then submitted to a mechanical sifting in order to classify them according to size, the duration of the fermentation and drying not being the same with the large and small ones.

The largest ones undergo another rolling differing a little from the first in the duration of the pressure exerted by the top piece. A certain number of the large leaves are broken. The large leaves are then again sifted and rolled, and finally sifted for the last time. Thus classified, the leaves are submitted to a fermentation, which, destroying the acid materials that they contain, permits of preserving them and giving them color and aroma.

The leaves are spread out in a cool place upon the floor in layers of about three inches in thickness, and are covered with wet canvas in order to prevent too great a heating of the mass. At the end of a period of time varying from one to two hours and a half, and according to the class, the leaves assume a coperish color, become less viscid, and acquire an agreeable odor. In order to free them from the humidity that they still contain, they are carried to a drying stove called a "sirocco." The most widely used type of this consists of a large dryer constructed of sheet iron, the fire-box of which is surrounded by a jacket provided with orifices through which the smoke passes at the lower part after having first circulated around the jacket and impinged upon flat ducts that communicate on the one hand with the external air and on the other with the upper part of the sirocco. There is thus produced a current of hot air which passes over four frames on which are spread the leaves to be dried, and which can be easily slid out of the apparatus through doors in its side. Beneath the frames are ar-

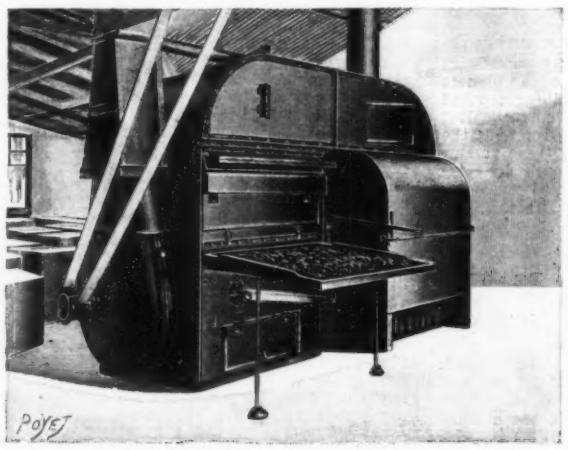


FIG. 2.—DRYING-STOVE OR "SIROCCO."

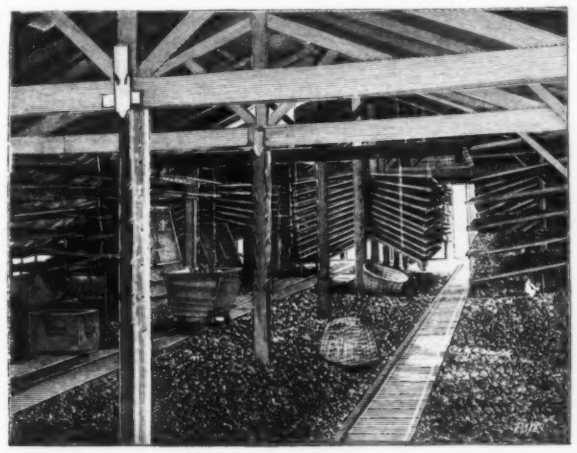


FIG. 3.—FRAMES UPON WHICH THE LEAVES ARE WILTED.

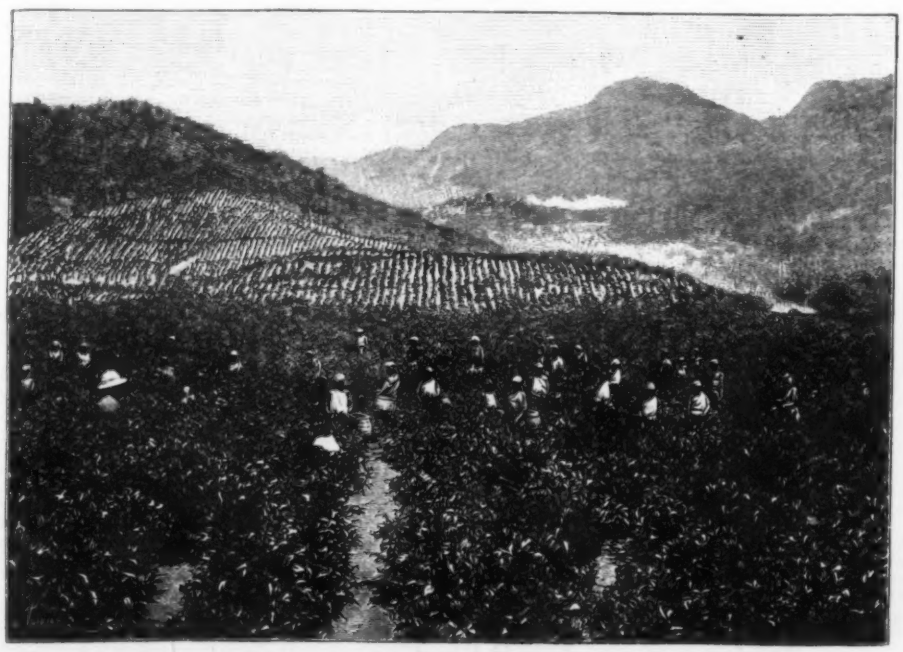


FIG. 4.—PLUCKING TEA LEAVES NEAR ADAM'S PEAK IN CEYLON.

FIG. 5.—PROCESS OF ROLLING TEA LEAVES STILL EMPLOYED IN JAPAN.

ranged counteracting shutters that throw out of the heated parts the dust of the leaves, which, upon being consumed, would disengage a smoke and odor prejudicial to the aroma of the tea.

The leaves are taken out several times and stirred up until they become brittle and no longer contain any trace of humidity. The temperature to which they are submitted varies from 93 deg. to 140 deg. C. (199.4 deg. to 219.2 deg. F.). The frames containing the large leaves are gradually lowered nearer and nearer to the fireplace.

This operation, which lasts about 20 minutes, is a very delicate one, since if the tea is too much dried it becomes burned, and, if not sufficiently, it remains damp and cannot be pressed.

These apparatus furnish 165 pounds of tea an hour, and certain types are even capable of producing more than 350 pounds.

The preparation of the tea is now finished, and all that remains to be done is to sort and classify the leaves according to quality. In Ceylon, for this purpose, mechanical apparatus is used, consisting of four or five screens, the meshes of which become finer and finer in a downward direction. The tea, retained by each of them, makes its exit through orifices arranged for the purpose.

The leaves are put into the sirocco for a second time and are finally packed in wooden chests lined with zinc in order to preserve the tea from humidity and prevent its aroma from becoming dissipated.

Such are the processes by which the tea industry has taken so rapid a development in Ceylon, and by which it is possible to annually export more than 120 million pounds.

In consequence of the extent of the manufacture of tea in her colonies, England, although having greatly increased her consumption, has been enabled to diminish her purchases in China to a considerable degree. Thus, in 1850, she was consuming Chinese tea only, while at present the latter forms but a tenth part of her annual consumption. Eight-tenths of the consumption of England is derived from her rich colonies of the Indies and Ceylon.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

THE SCIENCE OF ASTRONOMY.*

I TAKE for the subject of my address the science of astronomy, and propose to give a brief historical sketch of it, to consider its future development and to speak of the influence of the science on civilization.

The science of astronomy is so closely connected with the affairs of life, and is brought into use so continuously and in such a systematic manner, that most people never think of the long labor that has been necessary to bring this science to its present condition. In the early times, it was useful to the legislator and the priest for keeping records, the times of public ceremonies and of religious festivals. It slowly grew into the form of a science and became able to make predictions with some certainty. This was many centuries ago. Hipparchus, who lived 150 B. C., knew the periods of the six ancient planets with considerable accuracy. His periods are:

	Period. d.	Error × 100. Period. d.
Mercury	87.9698	+0.0007
Venus	224.7028	+0.0009
Earth	365.2599	+0.0010
Mars	686.9785	—0.0002
Jupiter	4332.3192	—0.0061
Saturn	10758.3222	—0.0083

These results indicate that more than two thousand years ago there existed recorded observations of astronomy. Hipparchus appears to have been one of those clear-headed men who deduce results from observations with good judgment. There was a time when those ancient Greek astronomers had conceived the heliocentric motions of the planets, but this true theory was set aside by the ingenious Ptolemy, who assumed the earth as the center of motion, and explained the apparent motions of the planets by epicycles so well that his theory became the one adopted in the schools of Europe during fourteen centuries. The Ptolemaic theory flattered the egotism of men by making the earth the center of motion, and it corresponded well with old legends and myths, so that it became interwoven with the literature, art and religion of those times. Dante's construction of Hell, Purgatory and Paradise is derived from the Ptolemaic theory of the universe. His ponderous arrangement of ten divisions of Paradise, with ten Purgatories and ten Hells, is said by some critics to furnish convenient places for Dante to put away his friends and his enemies, but it is all derived from the prevailing astronomy. Similar notions will be found in Milton, but modified by the ideas of Copernicus, which Milton had learned in Italy. The Copernican theory won its way slowly, but surely, because it is the system of nature, and all discoveries in theory and practical astronomy helped to show its truth. Kepler's discoveries in astronomy, Galileo's discovery of the laws of motion and Newton's discovery of the law of gravitation put the Copernican theory on a solid foundation. Yet it was many years before the new theories were fully accepted. Dr. Johnson thought persecution a good thing, since it weeds out false men and false theories. The Copernican and Newtonian theories have stood the test of observation and criticism, and they now form the adopted system of astronomy.

The laws of motion, together with the law of gravitation, enable the astronomer to form the equations of motion for the bodies of our solar system; it remains to solve these equations, to correct the orbits, and to form tables of the sun, moon and the planets. This work was begun more than a century ago, and it has been repeated for the principal planets several times, so that now we have good tables of these bodies. In the case of the principal planets, the labor of determining their orbits was facilitated by the approximate orbits handed down to us by the ancient astronomers, and also by the peculiar conditions of these orbits. For the most part, the orbits are nearly circular; the planets move nearly in the same plane, and their motions are in the same direction. These are the conditions Laplace used as the foundation of the nebular hypothesis. With approximate values of the periods and motions, and under the other favoring conditions, it was not difficult to form tables of the planets. However, the general problem of determining an orbit from three observations, which furnish the necessary and sufficient data, was not solved until about a century ago. The orbits of comets were first calculated with some precision. Attention was called to these bodies by their threatening aspects and by the terror they inspired among people. It was, therefore, a happy duty of the astronomers to show that the comets also move in orbits around the sun and are subject to the same laws as the planets. This work was easier, because the comets move nearly in parabolas, which are the simplest of the conic sections. Still, the general problem of finding the six elements of an orbit from the six data given by three observations remained to be solved. The solution was given by Gauss a century ago in a very elegant manner. His book is a model, and one of the best ever written on theoretical astronomy. No better experience can be had for a student than to come in contact with such a book and with such an author. The solution of Laplace for the orbit of a comet is general, but demands more labor for computing than the method of Olbers, as arranged by Gauss. It is said by some writers that the method of Laplace is to be preferred because more than three observations can be used. In fact, this is necessary in order to get good values of the derivatives of the longitudes and latitudes with respect to the time, but it leads to long and rather uncertain computations. Moreover, it employs more data than are necessary, and thus is a departure from the mathematical theory of the problem. This method is ingenious, and by means of the derivatives it gives an interesting rule for judging of the distance of a comet from the earth by the curvature of its apparent path, but a trial shows that the method of Olbers is much shorter. Good preliminary orbits can now be computed for comets and planets without much labor. This, however, is only a beginning of the work of determining their actual motions. The planets act on each other and on the comets, and it is necessary to compute the result of these forces. Here again the conditions of our solar system furnish peculiar advantages. The great mass of the sun exerts such a superior force that the attractions of the planets are relatively small, so that the first orbits, computed by neglecting this interaction, are nearly correct. But the interactions of planets become important with the lapse of time, and the labor of computing these perturbations is very great. This work has been done repeatedly, and we now have good numerical values of the theories of the principal planets, from which tables can be made. Practically, therefore, this question appears to be well toward a final solution. But the whole story has not been told.

The planets, on account of their relative distances being great and because their figures are nearly spherical, can be considered as material particles, and then the equations of motion are readily formed. In the case of n material particles acting on each other by the Newtonian law, and free from external action, we shall have $3n$ differential equations of motion, and $6n$ integrations are necessary for the complete solution. Of these only ten can be made, so that in the case of only three bodies there remain eight integrations that cannot be found. The early investigators soon obtained this result, and it is clearly stated by Lagrange and Laplace. The astronomer, therefore, is forced to have recourse to approximate methods. He begins with the problem of two bodies, the sun and a planet, and neglects the actions of the other planets. In this problem of two bodies, the motions take place in a plane, and the integrations can all be made. Two constants are needed to fix the position of the plane of motion, and the four other constants pertaining to the equations in this plane are easily found. This solution is the starting point for finding the orbits of all the planets and comets. The mass of the sun is so overpowering that the solution of the problem of two bodies gives a good idea of the real orbits. Then the theory of the variation of the elements is introduced, an idea completely worked out into a practical form by Lagrange. The elements of the orbits are supposed to be continually changed by the attractions of the other planets. By means of this theory, and the mathematical machinery given by Lagrange, which can be applied to a great variety of questions, the observations of the planets can be satisfied over long intervals of time. When this theory of the motions was carried out a century ago, it appeared that the great problem of planetary motion was near a complete solution. But this solution depends on the use of series, which undergo integrations that may introduce small divisors. An examination of these series by Hansen, Poincaré and others indicates that some of them are not convergent. Hence the conclusions formerly drawn about the stability of our solar system are not trustworthy and must be held in abeyance. But looking at the construction of our system, and considering the manner in which it was probably evolved, it appears to be stable. However, the mathematical proof is wanting. In finding the general integrals of the motions of n bodies, the assumption that the bodies are particles gets rid of the motions of rotation. These motions are peculiar to each body and are left for special consideration. In the case of the earth, this motion is very important, since the reckoning of time, one of our fundamental conceptions, depends on this motion. Among the ten general integrals that can be found, six belong to the progressive motion of the system of bodies. They show that the center of gravity of the system moves in a right line and with uniform velocity. Accurate observations of the stars now extend over a century and a half, and we are beginning to see this result by the motion of our sun through space. So far, the motion appears to be rectilinear and uniform, or the action of the stars is without influence. This is a matter that will be developed in the future. Three of the other general integrals belong to the theory of areas, and Laplace has drawn from them his theory of the invariable plane of the system. The remaining integral gives the equation of living force. The question of relative motion remains, and is the problem of theoretical astronomy. This has given rise to many beautiful mathematical investigations and developments into series. But the modern researches have shown that we are not sure of our theoretical results obtained in this way, and we are thrown back on empirical methods. Perhaps the theories may be improved. It is to be hoped that the treatment of the differential equations may be made more general and complete. Efforts have been made in this direction by Newcomb and others, and especially by Gylden, but so far without much practical result.

The problem of three bodies was encountered by the mathematicians who followed Newton, and many efforts were made to solve it. These efforts continue, although the complete investigations of Lagrange appear to put the matter at rest. The only solutions found are of very special character. Laplace used one of these solutions to ridicule the doctrine of final causes. It was the custom to teach that the moon was made to give us light at night. Laplace showed by one of the special solutions that the actual conditions might be improved and that we might have a full moon all the time. But his argument failed, since such a system is unstable and cannot exist in nature. But some of the efforts to obtain partial solutions have been more fruitful, and G. W. Hill has obtained elegant and useful results. These methods depend on assumed conditions that do not exist in nature, but are approximately true. The problem of two bodies is a case of this kind, and the partial solutions may illustrate, but will not overcome, the fundamental difficulty.

The arrangement of our solar system is such that the distances of the planets from one another are very great with respect to their dimensions, and this facilitates very much the determination of their motions. Should two bodies approach very near each other, the disturbing force might become great, even in the case of small masses. In the case of comets, this condition happens in nature, and the comet may become a satellite of a planet and the sun a disturbing body. In this way, it is probable that comets and meteoric streams have been introduced into our solar system. We have here an interesting set of problems. This question is sometimes treated as one of statics, but since the bodies are in motion it belongs to dynamics. Further study may throw light on some relations between asteroids and the periodical comets.

The great question of astronomy is the complete and rigorous test of the Newtonian law of gravitation. This law has represented observations so well during a century and a half that it is a general belief that the law will prove true for all time and that it will be found to govern the motions of the stars as well as those of our solar system. The proof is cumulative and strong for this generality. It will be a wonderful result if this law is found rigorously true for all time and throughout the universe. Time is sure to bring severe tests to all theories. We know that the law of gravitation is modified in the motions of the matter that forms the tails of comets. There is an anomaly in the theory of Mercury which the law does not explain, and the motion of our moon is not yet represented by theory. The lunar theory is very complicated and difficult, but it does not seem probable that the defect in Hansen's theory will be found by recomputing the periodical coefficients, that have been already computed by many mathematicians and astronomers, and with good agreement by Hansen and Delaunay, by very different methods. Hansen was a computer of great skill, but he may have forced an agreement with observations, from 1750 to 1850, by using a coefficient of long period with an erroneous value. No doubt the error of this theory will be discovered. Back of all theories, however, remains the difficulty of solving the equations of motion so that the result can be applied with certainty over long periods of time. Until this is done, we shall not be able to subject our law to a crucial test.

The constants that enter the theories of the planets and moon must be found from observations. In order to compare observations made at distant epochs, the motions of the planes of reference must be known with accuracy, and also the motion of our solar system in space. As the stars are our points of reference, their positions and their proper motions must be studied with great care. This department of astronomy was brought to a high degree of order by the genius of Bessel, whose work forms an epoch in modern astronomy. The recent progress made in determining the positions of the stars in all parts of the heavens will be a great help to the investigations of the future. We must have observatories where accurate and continuous observations are made. Our country is well situated to supplement the work of Europe, and we hope it will never fail to add its contribution to the annals of astronomy. American astronomers should keep pace in the improvements for increasing the ease and accuracy of making observations. The spectroscope has given a new element in the motions of the stars, not to speak of the interesting physical results obtained by its use. Photography will give great aid in determining the relative positions of the stars and in forming maps of the heavens. All new methods, however, will need examination and criticism, since they bring new sources of error. Fifty years ago, it was thought the chronograph would increase very much the accuracy of right ascensions. It has not done this directly to any great extent, but it has increased the ease and rapidity of observing. We must remember that astronomical results finally depend on meridian observations, and that it is the duty of astronomers to make these continuous from generation to generation. In this way, we shall gain the powerful influence of time to help control and solve our problems. There is one point where a reform may be needed from the dead weight of the large and expanding volumes sent forth by observatories and scientific institutions. The desire for publication is great, but the results should be well discussed and arranged, so that the printing may be shortened. Otherwise our publications may become burdensome, and when they are piled up in libraries some future Caliph Omar may be tempted to burn them. Even mathematics appears to labor under a similar oppression, and much

* Address delivered by Prof. Asaph Hall, on December 29, 1902, as president of the American Association for the Advancement of Science, Washington meeting.

of its printed matter may be destined to molder to useless dust.

In the not distant future, stellar astronomy will become a great and interesting field of research. The data for the motions of the stars are becoming better known, but these motions are slow, and the astronomer of to-day looks with envy on the astronomer of a thousand years hence, when time will have developed these motions. Much may be done by the steady and careful work of observation and discussion, and the accumulation of accurate data. Here each one of us can add his mite. But the great steps of progress in science have come from the efforts of individuals. Schools and universities help forward knowledge by giving to many students opportunities to learn the present conditions and from them some genius like Lagrange or Gauss may come forth to solve hard questions and to break the paths for future progress. This is about all the schools can do. We need a body of men who can give their lives to quiet and continuous study. When the young Laplace was helped to a position where he could devote his life to research, D'Alembert did more for the progress of astronomy than all the universities of Europe.

One needs only to glance at history to see how useful astronomy has been in the life of the world. It has wonderfully enlarged the universe and widened the views of men. It shows how law and order pervade the world in which we live; and by the knowledge it has disseminated and by its predictions it has banished many superstitions and fears. The sciences will continue to grow, and they will exert the same influence. The erroneous and dogmatic assertions of men will be pushed aside. In our new country, the energies of the people are devoted chiefly to commercial and political ends, but wealth is accumulating, leisure and opportunity will come, and we may look forward to a great development of scientific activity. We must be patient. Men do not change much from generation to generation. Nations that have spent centuries in robbery and pillage retain their dispositions and make it necessary for other nations to stand armed. No one knows when a specious plea for extending the area of civilization may be put forth, or when some fanatic may see the hand of God beckoning him to seize a country. The progress of science and invention will render it more difficult for such people to execute their designs. A century hence it may be impossible for brutal power, however rich and great, to destroy a resolute people. It is in this direction that we may look for international harmony and peace, simply because science will make war too dangerous and too costly.

The influence of the sciences in bringing men of different nationalities into harmony is great. This is done largely by the common languages that are formed in each science. In mathematics, the language is so well formed and generally adopted that mathematicians all over the world have no trouble in understanding one another. It may be difficult to read Russian, but everyone can read the formulas of Tchebitchef and Lobaschewsky. In astronomy, the common language is nearly as well established, so that there is little difficulty in understanding the astronomy of different nations. A similar process is going on in chemistry, botany and in the other sciences. When men are striving for the discovery of truth in its various manifestations, they learn that it is by correcting the mistakes of preceding investigators that progress is made, and they have charity for criticism. Hence persecution for difference of opinion becomes an absurdity. The labors of scientific men are forming a great body of doctrine that can be appealed to with confidence in all countries. Such labors bring people together, and tend to break down national barriers and restrictions. The scientific creed is constantly growing and expanding, and we have no fears, but rejoice at its growth. We need no consistory of bishops, or synod of ministers, to tell us what to believe. Everything is open to investigation and criticism.

In our country we have one of the greatest theaters for national life that the world has ever seen. Stretching three thousand miles from ocean to ocean, and covering the rich valleys of the great rivers, we have a land of immense resources. Here is a vast field for scientific work of various kinds. No doubt the men of the future will be competent to solve the problems that will arise. Let us hope that our national character will be just and humane, and that we may depart from the old custom of robbing and devouring weak peoples. Anyone who saw the confusion and waste in this city in 1862 might well have despaired of the Republic; and he who saw the armies of Grant and Sherman pass through the city in 1865 felt that he need fear no foreign foe; neither French emperor, nor English nobleman nor the sneers of Carlyle. To destroy a democracy by external force, the blows must be quick and hard, because its power of recuperation is great. The danger will come from internal forces produced by false political and social theories, since we offer such a great field for the action of charlatans. Our schools and colleges send forth every year many educated people, and it is sometimes disheartening to see how little influence these people have in public life. Those who are trained in the humanities and churches ought to be humane in dealing with other people, ready to meet great emergencies and powerful to control bad tendencies in national affairs. But this is rarely the case. On the other hand, the most unscrupulous apologists and persecutors have been educated men, and the heroes of humanity have come from the common people. This anomaly points to something wrong in the system of education, which should disappear. The increase and teaching of scientific ideas will be the best means of establishing simple and natural rules of life. Nature, and science her interpreter, teach us to be honest and true, and they lead us to the Golden Rule.

ANOTHER NEW COMET.

KNOWLEDGE says a new comet was discovered on December 2, and, though extremely faint at present, it occupies a very favorable position for observation. Early in December it was estimated as about magnitude 11½. On January 1, 1903, the comet will be placed about nine degrees west of the bright star Procyon, and a week later may be found some eight degrees west of β Canis Minoris. At this period the comet will be nearly three times as bright as it was on the night of its discovery. Its motion is slow toward the northwest, and directed to the stars in the western region of Gemini. The comet is well visible during nearly the whole night, and promises to remain in view for a considerable period, for according to the elements of the orbit computed by Ebell at Kiel (*Ast. Nach.*, 3834), the perihelion passage will not take place until April 19 next.

THE BEHAVIOR OF BLIND ANIMALS.

BY PROF. WESLEY MILLS, M. A., M. D., McGill University, Montreal.

IN the course of years I have had the opportunity of observing a considerable number of animals totally blind in either one or both eyes and to these only shall I refer in this paper.

Pigeons.—All those observed that were otherwise normal, have been blind on one side only. The defect does not seem to have resulted in any great inconvenience or disadvantage to the individual. Birds do not, it is likely, possess binocular vision, in the sense in which the term may be applied to many mammals; and in consequence of the defect, cutting off the field of vision on one side completely, the bird endeavors to make up for this by adaptive movements of the head, which it can bring about with a facility not possible to the mammal.

It also, through experience, becomes more alert than the average pigeon; nevertheless, when the struggle for existence becomes keen, as for example when a limited quantity of food is strewn about, it is shown to be plainly at a disadvantage, both in securing the food and in the bodily conflicts that are apt to arise between it and its competitors.

White Rats.—I have observed several white rats, some of which were blind in only one eye, others in both. The results were in some respects very different from what might have been expected, and in this the difference between the bird and the rabbit, on the one hand, and the rat, on the other, was striking.

Even in the case of total blindness, the rat is not handicapped as one might suppose must be the case. In a very few days the rat blind in only one eye seems to ordinary observation to be in no appreciable degree worse off than his fellows. In a short time the specimen, totally blind, moves about so well that one would need to look carefully to be assured that he gets no assistance from the visual sense. But in his case there are times when it is evident that he is handicapped. In exploring new surroundings he proceeds with special caution, stretching out his neck, sometimes resting on his hind legs, more frequently elevating his fore parts and sniffing in an unusual way, showing an extreme care and plainly making use of his acquired greater facility, or perhaps one should say, his accustomed and habitual greater use of senses that normally are not required to function to such a marked degree.

He is also somewhat more timid, and retreats in the way rats do toward their place of exit, with greater readiness. He is of course more at the mercy of his enemies, and yet not to the degree one might have supposed, on account of his greater caution as well as the fact that his senses of touch and smell make up so fully for the lack of sight. It must be borne in mind that the olfactory tracts of the central nervous system in the rat are highly developed and their association-paths numerous, so that in an eminent degree the rodent, and especially the rat, is worked, so to speak, as an entire mechanism largely through the reflex paths of smell.

One of the unexpected results of sudden blindness in the case of white rats, whether affecting one or both eyes, was a most marked alteration in disposition. Rats that were perfectly tame became at once ferocious; it was unsafe any longer to attempt to handle them as formerly, or to remove anything from their cage, for in an instant they seemed aware of the approach of one's hand and were not only ready but able to pounce upon it at once; even metal forceps were seized by the teeth. After a considerable period in a rat blind in both eyes this ferocity disappeared, but not so, or to but a slight extent, in those lacking the power of vision on only one side.

In our experience in the breeding of white rats, it is rare for the female to devour her young, but invariably have those blind white rats killed and eaten to a greater or less extent every litter they have had, though placed under circumstances exactly similar to those of the intact rats.

Rabbits.—My opportunities to observe this species of rodent when blindness was found on one or both sides, have been almost as good as in the case of the rat. The difference noted in the animals is considerable. A rabbit totally blind behaves in general much like a rat similarly defective, but he shows less tendency on occasion to retreat toward his place of safety, is less alert and apparently less prepared to meet emergencies. But the readiness with which he manages to avoid obstacles in his path is striking. He also, like the rat, stretches out his neck, rises sometimes on his hind legs, but more frequently raises the fore part of his body into the air, all with the obvious purpose of exploring the nature of his environment to a degree and with a frequency not witnessed in the normal rabbit. Such an animal is, however, more likely to fall under the power of his enemies than is the rat, though so long as food is plenty near his burrow the wild animal would no doubt develop that caution and use his other senses to such an extent that he would generally escape; but that he would in the long run fall a prey to some wily fox seems more than probable.

I have noticed no change in disposition in the case of the rabbit akin to that in the rat and none of the blind specimens has had young.

Neither the rabbits nor the rats ever make the mistake of walking off a place elevated above *terra firma*. As I have elsewhere pointed out, this tendency seems to be a fundamental instinct manifested by even the youngest mammals and is evidently of vital importance for their preservation.

Cat.—The cat on which I am able to report was not in good condition after she became suddenly blind in both eyes, and lived but a few days, or I should have been able to note more fully whether her psychic state had been modified by experience.

When put down on the floor she moved about in a slow and apparently cautious way, and, though plainly perfectly blind, when she came near objects she touched them only slightly. In this the whiskers evidently served a good purpose, as was also observed in the rodents. When one made a noise on the floor as by tramping with the feet, puss invariably moved toward the sound, and so perfectly that by walking about one could cause her to describe complicated figures, from which and other observations I conclude that she had become a mere reflex mechanism worked by the most prominent stimuli of the moment from the external world. When she came to a wall, and especially a corner, she stopped and sometimes lay down—showing that the "puss in the corner" tendency has a deep foundation, for I am inclined to believe that this animal was not conscious in the true sense of the term. This cat had become blind owing to a hemorrhage into the optic thalamus of the brain and lived but a few days afterward.

I have not reported any other cases in this paper in which there were brain lesions, the discussion being too complicated for my present purpose. That the cat was guided purely reflexly by sounds was evident from the fact that when one stood on a table and tramped as before, puss underneath the table was soon brought to a standstill just below the source of the sounds. Such a remarkable case of guidance reflexly by the ear I had not seen before, and it proved very instructive to me.

Dog.—Of the blind dogs I have observed I shall refer to but one. He was a cross-bred Skye terrier and formed one of a litter kept in a room in the college basement. He became totally blind when between two and three months old. After this he soon changed greatly in disposition; he, like the rats, seemed to revert to a sort of feral condition. He would on the entrance of any one into the room hide, and when approached would bite savagely at the extended hand; in fact, in order to catch him it was necessary to throw a sack or some such object over him. He had gnawed away the legs on which his cage stood and to which he was chained for a time.

This dog seemed to be at least equal in intelligence to the other members of the litter, his companions. So far as the objects in the room that had a stable situation were concerned, he was perfectly oriented, but if a new object was laid down he would run against it and then attack it as savagely as he would one of his fellows who came in his way.

If any stranger came to the door of the room he seemed to know instantly and would bark fiercely, but he never did this when the regular attendant entered, however silently he approached, being guided probably largely, but by no means wholly, by the sense of smell. He was by far more alert than any of his companions and seemed to be put into a state of high tension by the slightest stimulus.

This dog had a ravenous appetite, and when the vessel containing food for all the dogs of this litter was put down he was generally the first to reach it, though at the moment he might possibly be in the most distant part of the room, and certainly he did not come off second best in the struggle.

He was so like a wild animal, was of so bad a temper, and altogether so undesirable a creature, I thought it best to chloroform him at the end of a few weeks.—Popular Science Monthly.

A SCIENTIFIC SEAFARING FAMILY.

THE Rev. T. R. R. Stebbing continues in Knowledge his genial survey of some little-known crustaceans, whose long names are almost as remarkable as their wonderful structure. Discussing the Cryptochelata, he remarks: "A man is said to pocket an affront when he demurely lets it pass as though it had not been offered. 'The chela-concealing' Cryptochelata have no pocket-like cavities with which to hide their nippers. They either let them vanish altogether, or retain them like superannuated dimples as an ineffective reminiscence of infancy. In classification, however, these disestablished or disendowed chelifori are still useful. They serve to discriminate three families of this section. In the Ammotheidæ they are small, rudimentary, and, in contradiction to their title, not cheliferous. They are small also in the Eurycydidæ, but there imperfectly chelate. In the Colossendeidæ they are entirely wanting. It will not be forgotten that these distinctions apply to the adults, the appendages in question being, so far as is known, present and chelate in the young of all the Pycnogonida. In the first of the three families above mentioned there are several genera, exactly how many it is not easy to say, because some that are imposing in name are very obscure in nature. Thus *Oiceobathes*, Hesse, 'with its home in the abyss,' is perhaps the same as *Ammothea*, of which two species have their home on our own shores and shallows. *Pephredo hirsuta*, described by Goodsir, from the German Ocean, is thought by Hoek to be generically the same as *Phanodemus* which Costa instituted earlier for species from the Bay of Naples. *Clotenia*, Dohrn, and *Discoarachne*, Hoek, are, in the opinion of Dr. Hoek himself, closely approximate. They were published in the same year, 1881. Both authors date their work in the same month, Hoek on May 19, at Leiden, Dohrn on May 31, at Naples. But although Dr. Hoek's 'Challenger' report, as he subsequently explained, was ready to appear at the beginning of July, it was not actually issued till October, whereas Dr. Dohrn's Neapolitan monograph was at the service of the public in the preceding September. But the dates are perhaps not the only consideration. In *Clotenia* we find the chelifori dwarfed each to a little stump or tubercle. In *Discoarachne* not even so much as this is either mentioned or figured, so that the name must not be canceled as a synonym without demur. The disappearance of these little vestigial stumps would probably make no difference to the animal. Nature would view it with unconcern. But the neat simplicity with which our three families have been discriminated will be very much disfigured by it, for the total absence of the chelifori is used as a mark of the third family, not of the first."

[Continued from SUPPLEMENT No. 1419, page 22747.]

HIGH TEMPERATURE ELECTRO-CHEMISTRY: NOTES ON EXPERIMENTAL AND TECHNICAL ELECTRIC FURNACES.*

By R. S. HUTTON, M.Sc., Associate, and J. E. PETAVEL, Associate Member.

PART II.—NOTES ON TECHNICAL PROCESSES.

In the comparatively short time which is at our disposal it would be altogether impossible to give any adequate account of the general development of the industry. We shall, therefore, neither touch on the historical side of the subject, which has already been fully treated by others, nor do we propose to give a complete account of the methods in use in such widely developed industries as calcium carbide, aluminium, etc. Our object will be more especially to consider some of the newer industries, to draw attention to recent advances in the older ones, and to consider, where possible, the directions in which improvements are to be expected. In connection with each subject a few references are given which may be of interest to those desiring more complete information. In order to facilitate the description, a diagrammatic representation of the principal types of electric furnaces is given in Fig. 13.

Calcium Carbide.*—We have not here to deal with the economical side of the subject, but it may be said that the financial crisis through which the carbide industry has recently passed influenced very considerably its progress.† Previously the manufacture of carbide was being taken up in innumerable small factories with processes differing very largely as to their efficiency. The present circumstances have eliminated the less efficient methods, and the comparatively few firms which are still successful owe their advantage to the careful consideration they have given to the perfection of the mechanical details. Speaking generally, it may be said that the tendency, here, as in other manufactures, has been to simplify the process as much as possible. The current regulation is automatic,‡ and is achieved either by raising the vertical electrodes when the "pot" type of furnaces are used, or by some other means of bringing more resisting material between the electrodes. Means are frequently provided for automatic grinding, weighing, and mixing of materials. With regard to the labor-saving problem a continuous furnace possesses obvious advantages. A great deal of discussion has arisen with regard to the relative merits of the "continuous" and "discontinuous" furnaces, but this is largely due to a confusion of terms, since the tapping methods,* which undoubtedly give a poorer grade carbide, are by no means the only continuous ones; in fact with such furnaces as the Horry, Siemens and Halske, etc., all the advantages of a continuous process are attained, without the great loss of heat which is entailed by the removal of the molten carbide from the furnace. The production of calcium carbide being a purely electro-thermal operation, either continuous or alternating current can be used, but the balance of advantage seems to be decidedly in favor of alternating current, which lends itself more easily to long-distance transmission. An alternating plant is, moreover, more suitable to withstand the sudden and intense variations in load, which it is at times impossible to avoid, and the carbide produced is said to be more uniform in quality.†

Three-phase current, which has been employed notably at St. Marcello d'Aosta,‡ has the advantage of giv-

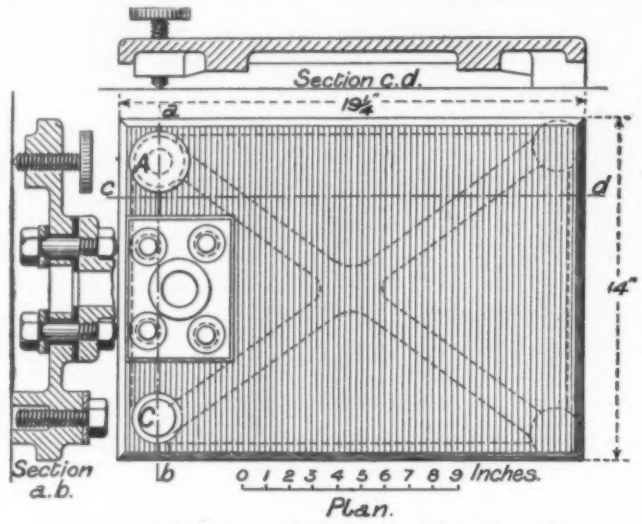


FIG 7.—VERTICAL ELECTRIC FURNACE PLAN.

The apparatus consists of a cast-iron base, an adjustable standard and feeding gear. The base is ⅝ inch ruling thickness, strengthened with rims and cross-ribs 1 inch thick. At one corner a ¾-inch bolt, C, serves as a terminal. A is a leveling screw. The square base of the standard is insulated by a slab of vulcanized fiber, and held down by four ¾-inch bolts. See section A-B.

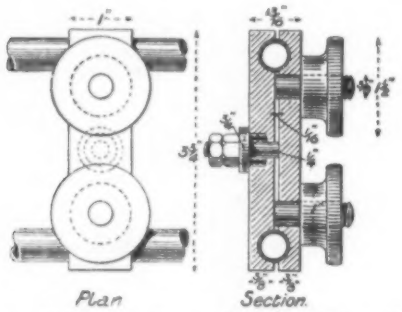


FIG. 5.—SLIDERS FOR 1,000-AMPERE WATER TUBE RESISTANCE.

These are used to regulate the larger currents, one being moved a short distance while the other remains fixed, this latter being in turn advanced. The E.M.F. on the moving slider is thus kept small and sparking avoided.

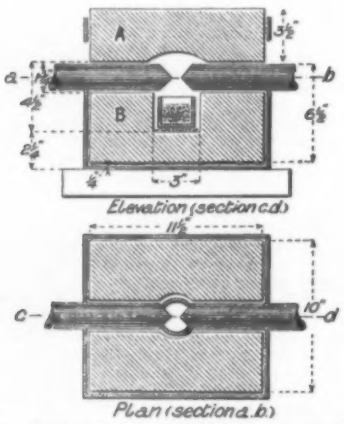


FIG. 6.—40-KILOWATT MOISSAN FURNACE.

This is constructed of blocks of Monk's Park bath stone, which after trials with various limestones has proved to be the most suitable. The furnace is composed of two blocks, the first, A, forming the cover, the second, B, the furnace proper. This latter has two grooves of slightly greater diameter than the carbons to be used. As the blocks are apt to split under the influence of the heat, they are held together by iron bands; these are provided with sockets (not shown in figure) which enable the furnace or cover to be lifted by long iron bars. The central hole, which may be of diameter 2¼-4 inches, according to size of crucible in use, is lined at the bottom by a layer of powdered magnesia which prevents the carbon crucible coming in direct contact with the lime. An annular space should be left around the crucible, which not only facilitates the heating, but also prevents the lime and carbon from entering into combination.

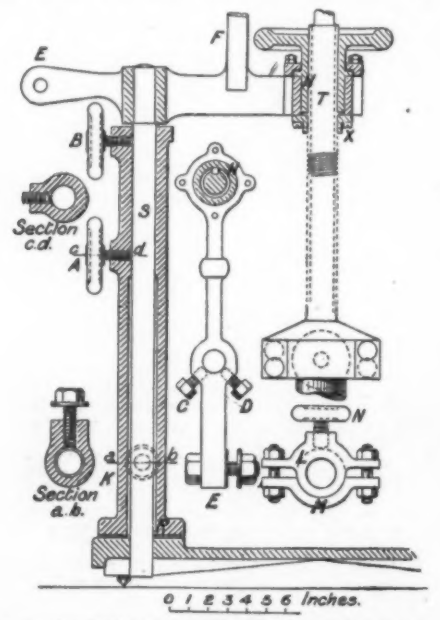


FIG. 8.—VERTICAL ELECTRIC FURNACE ELEVATION.

A hollow cast-iron column R 2¼ inches diameter is fixed to the base shown in the previous figure but insulated from it; the height of the gun-metal cross-bar carrying the screw feeding gear can be adjusted within wide limits by means of the 1¼-inch steel rod S which is clamped in position by the hand wheels A and B. Connection can be made at either of the terminals K or E (the latter for currents above 600 amperes), the opposite pole being connected to the base. To avoid sliding contacts which would be objectionable for such large currents connection from the cross-bar to the screw carrying the carbon rod is made by means of four ⅛-inch flexibles not shown in the figure, but which can be clearly seen in Fig. 9. The gun-metal rod T, which carries the carbon is 1⅛ inches diameter with square screw thread (4 threads to the inch), giving a feed of about 1 foot; it is raised or lowered by means of a 7 inch cast-iron hand wheel. The design of the carbon holder is clearly shown, it is provided with rings of various diameter, so that carbons of very different sizes up to 3 inches can be held.

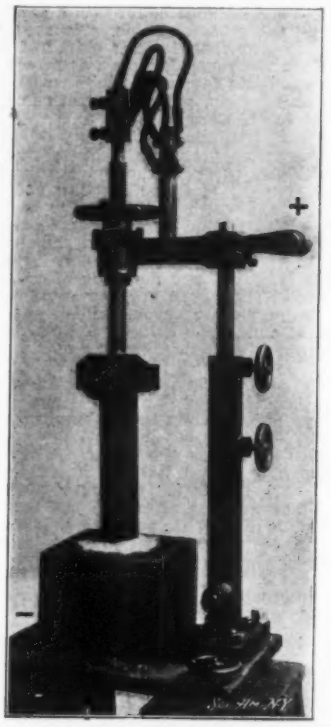


FIG. 9.—A. EXPERIMENTAL ALUMINIUM FURNACE.

This shows one way in which the vertical furnace, the design of which is shown in the previous figures, can be used. Upon the cast-iron base which forms the negative pole is placed a large block of carbon, having a cavity which serves as a crucible. The positive electrode is formed by a carbon 3 inches in diameter, which is fed by the screw-gear described above.

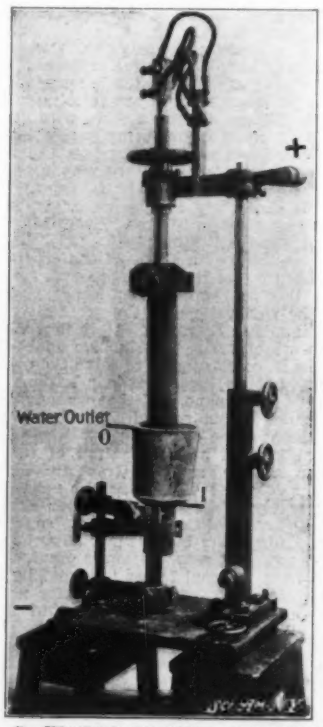


FIG. 9.—B. WATER-COOLED ELECTROLYTIC FURNACE.

Here the apparatus is fitted to be used for the electrolysis of fused salts; the water-jacket, by causing a layer of the fused mass to solidify, enables the electrolyte itself to form the crucible lining. This is frequently necessary, since with many substances it is impossible to find a furnace material capable of withstanding their corrosive action at the high temperatures which prevail. The negative pole is in this case formed by a vertical carbon, which is held in a clamp sliding on a gun-metal vertical rod fixed to the base.

* A paper read before the Institution of Electrical Engineers, and revised by Prof. Hutton for the SCIENTIFIC AMERICAN SUPPLEMENT.

* Vivian B. Lewes, Acetylene, London, 1900; Moissan, Comptes Rendus, vol. 115, 1031 (1892), vol. 118, 501 (1894); Moissan, General Review of Chemistry of Carbides, Rev. Général des Sciences, vol. 12, pp. 946-955 (1901).

† A careful estimate recently made points out that of the 254,000 H. P. installed for this manufacture, only some 64,000 H. P. are in use. Mineral Industry, vol. 10, p. 74 (1902).

‡ E. g. Horry, U. S. Patent 655,779 of 1900.

* Carlson, Zeitschr. für Electrochemie, vol. 6, pp. 413, 429 (1900); Frölich, Zeitschr. für Electrochemie, vol. 7, pp. 1-10 (1900).

† Pradon, Electrical Review, vol. 49, p. 463 (1901).

‡ Cesare Pio, Electrician, vol. 43, p. 537 (1899); Electrical World and Engineer, vol. 40, p. 375 (1902); Bertolus, Engl. Patent No. 16,942 (1897).

ing a more even distribution of temperature. It must be remembered that the most favorable temperature conditions are somewhat narrow,* and that too intense a heat can produce the phenomenon of "burning." Alternating current has, however, one serious disadvantage, namely, that the power-factor is somewhat low. Experience has shown that with a view to preventing both the inconvenience and loss caused by the dissipation of the finely divided material, it is necessary to have the furnace properly inclosed. This minimizes to a large extent the oxidation of the carbon electrodes, which is also an important question with regard to cost, and further enables the gases to be made use of for heating purposes. There seems to be a distinct gain to be achieved by finely dividing

FIG. 10.—EXPERIMENTAL CARBORUNDUM FURNACE.

This is an almost exact reproduction of the commercial furnace on a small scale. It is built up of loose fire bricks on a cast-iron base, the outside dimensions being 46 inches long, 28 inches broad, and 21 inches high. The electrodes, consisting each of two graphite plates 2½ × 1 inch, are in contact with coke, which also forms the core connecting the two. This is a resistance furnace of type E, shown in Fig. 13. The core is surrounded by the mixture of sand, coke, sawdust, and salt from which the carborundum is made.

and intimately mixing the raw materials, and in modern inclosed furnaces these appear now to give very little trouble.

The carbide industry has reached a large development in the United States, where at Niagara some 15,000 horse power are continuously in use. Although the distance of the works from the power house is only about two miles, it has been found economical to transform the 2-phase current generated at 2,200 volts, to 3-phase at 11,000 volts, the transformers being Scott connected and of capacity 2,500 horse power. At this pressure the current is received at the transformer-house close to the carbide works and transformed down, first to 2-phase 2,200 volts, then to 110 volts, at which it enters the furnaces.† At Sault Ste. Marie, a sister factory for 20,000 horse power is nearly complete. A plan of the Horry furnace given in Fig. 15 is of some interest, this being the type of furnace employed in these works.‡

Of other furnaces, those of Gin and Leleux§ and the Deutsche Gold u. Silber Scheide Anstalt‖ are among the most widely known, the former having been fitted up at Meran and in some parts of France and Italy, while the German firm have equipped several factories in Norway and elsewhere. The condition of the carbide industry is at the present time entirely dependent on the progress of acetylene lighting, and despite the unfortunate reaction caused by the flooding of the market by improperly constructed generators, now that the subject has received due attention and safe and reliable apparatus are available,¶ steady progress is being made.

Possibly the application of acetone as a solvent for acetylene,** enabling it to be safely stored under pressure, may influence its future considerably.

Other proposals for the use of calcium carbide, which have not as yet come into general use, include its application as a metallurgical reducing agent,†† and for the production of the finer grades of lampblack.‡‡

With regard to the efficiency of the manufacture, an important advance would undoubtedly result from any invention enabling the heating power of the waste gases to be more generally used for preliminary treatment of the raw materials. The combination of the lime kiln and the electric furnace would lead to a great economy of energy, but up to the present the practical difficulties have outweighed the theoretical advantage.

Refractory Metals and Their Alloys.—The difficulties in the way of the commercial application of the electric furnace having been successfully overcome in the case of calcium carbide, efforts were soon directed to the possibilities of producing some of the rarer metals on a large scale in a similar type of furnace. The valuable qualities of some of these metals in the manufacture of steels insured their finding a satisfactory market. Among these metals ferro-chromium takes an important place, chiefly on account of the large employment of chrome steels for the manufacture of armor plate, projectiles, tool steels, springs, etc. At the present time one factory alone in America is using 450 tons of 70 per cent ferro-chromium a year for armor plate work. For this country data are not easy to obtain, but doubtless, owing to the advanced state of the British steel trade, large quantities of these alloys are employed. The chief factories are situated in France and the United States. The Willson Aluminium Company, with works at Holcombs Rock, Va., and Kanawha Falls, W. Va., manufacture ferro-chromium and other alloys, using some 3,000 horse power at the latter works; the furnaces they employ are suitable for tapping, the metals being run into lined iron trucks, the automatic regulation as used in the carbide industry being also installed. Tungsten and ferro-tungsten, which have been used for a considerable time for manufacturing self-hardening and high-speed tool steel, can also be most satisfactorily manufactured in the electric furnace, and this product has considerable advantage in that it is in a compact fused form, and is thus less liable to oxidation in the process of adding to the steel. One of the most important of these alloys is ferro-silicon, the manufacture of which has been taken up in several of the factories in which calcium carbide can be no longer produced with sufficient economy. The grade varies considerably, from 15 per cent up to 85 per cent. The chief application of ferro-silicon is in the casting of iron and steel, where it plays the important rôle of deoxidizer, thus getting rid of blow-holes, and at the same time, owing to the high heat of combustion, renders the metal more fluid for casting.

As to copper silicon, this has been prepared for a long time in the furnace of Cowles, and has found considerable application as a deoxidizer, and for increasing the tensile strength in copper and brass castings. There seems every indication that silicon itself will soon displace its alloys for some of the more important work; it is now prepared in considerable quantities by the method of Scheid.* Among the rarer metals which have not as yet received any wide technical application, we may mention ferro-titanium and ferro-vanadium. Owing to recent work these metals have been shown to have considerable technical value in the steel industry, and the difficulties connected with their manufacture have been largely overcome. According to Rossi, the addition of titanium to pig-iron of whatever quality produces a considerable increase both in tensile and transverse strength.* A similar but less marked effect is produced on steel. It is evident that when dealing with raw material of such high value as is the case with some of these rarer metals, it is very necessary to have an electric furnace in which the process can be kept well under control, and in which the loss of material can be minimized as much as possible; this result has been achieved by using a properly closed furnace. The development of the industry of the rarer metals has been most materially assisted by the beautiful discovery of Dr. H. Goldschmidt in which the metallic oxides are reduced by finely divided aluminium; the process is worked at Essen, by the Allgemeine Thermit-Gesellschaft. This method at first sight possesses advantages over the direct electric furnace treatment, since metals with very low carbon content can be easily prepared, but the refining of the metals in the electric furnace is by no means impossible of accomplishment,† and will doubtless come more into general use and be further worked out as the industry increases. On the other hand, the Goldschmidt method is so indirect—aluminium, itself an expensive electric furnace product, being used—that, provided a sufficient demand for any given metal exists, no trouble should be found in overcoming the few difficulties which remain for preparing a sufficiently pure material, by a much more economical and more direct method.

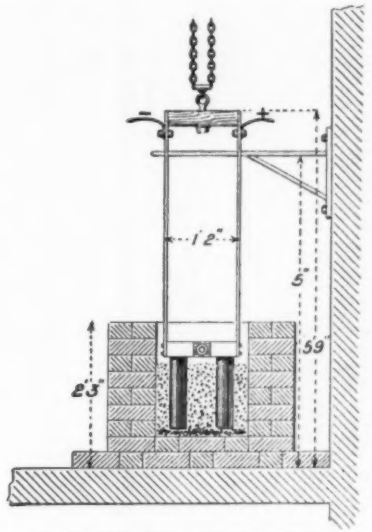


FIG. 11.—40-KILOWATT EXPERIMENTAL CARBIDE FURNACE.

This represents a satisfactory and convenient laboratory form of the many and important technical furnaces of type C, Fig. 13. The two carbons which are clamped side by side in a single holder, but insulated one from another, are raised and lowered by means of a crane fitted to the wall. The current is led in by flat copper bars, which by sliding in grooves prevent any oscillation or side motion of the apparatus. The body of the furnace consists either as shown in figure, of fire bricks, or of a large cast-iron pot; in both cases the material itself forms the actual lining.

Carborundum.—This industry, although by no means to be compared with calcium carbide so far as power is concerned, is of considerable importance and illustrates a type of furnace which is finding many other applications. A photograph will be found in the early part of the paper, Fig. 10, which, though on a smaller scale, gives a very good idea of the general appearance of such a furnace. The industry has increased very rapidly, for whereas in 1893, 6¾ tons were manufactured, in 1901 1,690 tons were produced, and the power in use has just been increased (September, 1902) from 2,000 horse power to 3,000 horse power, thus raising the output to some 2,690 tons. The manufacture of carborundum has often been describ-

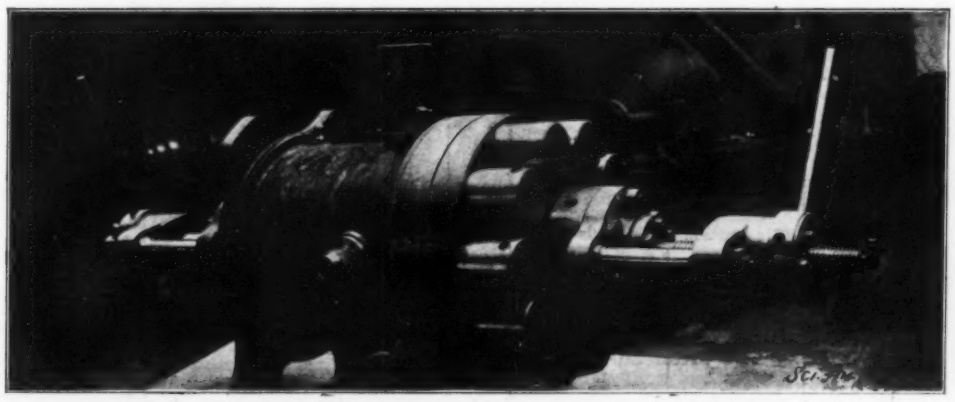


FIG. 12.—HIGH-PRESSURE ELECTRIC FURNACE.

The apparatus is practically a steel inclosure, placed either horizontally or vertically, which can be used for any of the different types of furnace. It is air-tight, and designed for a working pressure of 200 atmospheres, being tested at 500 atmospheres. On the right and left will be seen the screw-gear by which the carbons are fed, while in front and behind are windows which will stand the full pressure, but which can be replaced by additional connections when a circulation of gas through the apparatus is desired. The main valve, which serves also to connect the pressure gauges, will be seen on the top. The apparatus is water-jacketed throughout, the refractory material of which the furnace proper is made being contained in a cast-iron lining, thus insuring the protection of the main forging. The construction of this apparatus has been carried out by Messrs. Lennox, Reynolds and Fyfe to the designs made at the College.

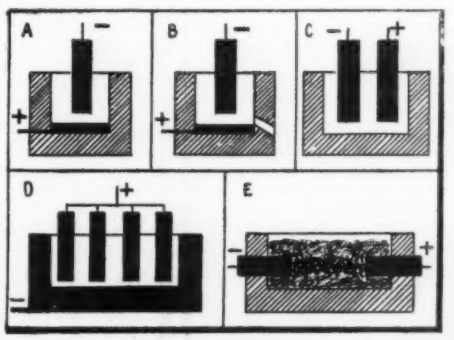


FIG. 13.—PRINCIPAL TYPES OF ELECTRIC FURNACES.

A represents the ordinary pot furnace in which the current passes between a movable carbon electrode and a carbon or other plate forming the base of the furnace. B is an example of a tapping furnace, being otherwise very similar to A. C. In this case the furnace proper is formed of insulating material (generally lined with the unacted-on mixture), the current passing between the two carbons. D represents electrolytic furnaces such as are used for aluminium, zinc, etc.; the current passes from one or several carbon electrodes forming the positive electrode to the negative pole, which is formed by the lining of the furnace. E. Resistance furnace: most frequently provided with a core through which the current is passed, and thus the surrounding material is heated. All the types except D are suitable either for alternating or direct current, the former being most frequently in use.

* Rothmund, Zeitschr. für anorganische Chemie, vol. 31, p. 136 (1902); Borchers, Zeitschr. für Electrochemie, vol. 8, p. 349 (1902).

† Electrical World and Eng., vol. 34, p. 794 (1899).

‡ Horry, English Patents, No. 22,521, 1897, and No. 14,361, 1899.

§ Borchers, Zeitschr. für Electrochemie, vol. 7, p. 236 (1900); Haber, Zeitschr. für angew. Chemie (1901), p. 158.

‖ Kershaw, Electrician, vol. 46, p. 267 (1900).

¶ Report of Committee on Acetylene Generators (Home Office), 1902.

** Fouché, Soc. Française de Physique, No. 171 (Nov. 15, 1901); Journal de l'Electrolyse, vol. 10, No. 122, p. 13 (1901).

†† V. Kilgelgen, Zeitshr. für Electrochemie, vol. 7, pp. 54, 441, 573 (1901).

‡‡ Hubou, Mémoirs de la Société des Ingenieurs Civils de France (1900).

* Scheid, Engl. Patent No. 18,659 of 1899.

* Rossi, Mineral Industry, vol. 9, p. 715 (1900); Goldschmidt, Zeitschr. für angew. Chemie, Heft 28 (1902).

† Moissan, Refining Chromium, Le Four Electrique, p. 200; see also Chemical Trade Journal, vol. 30, p. 453 (1902).

ed.* The raw materials which are heated together in a furnace of type E, Fig. 13, consist of coke and coal, a small percentage of sawdust and salt is added, the one to insure the porosity of the charge, the other to act as a flux. Carborundum, as is well known, has found large use as an abrasive, but of still more interest is its recent application in the steel industry, replacing to a considerable extent ferro-silicon. The importance of this development may be judged by the fact that the present consumption of carborundum for this purpose alone is 75 tons per month. Still more promise is shown by the proposed use of this substance for making highly refractory materials. In this connection the discovery of Fitzgerald of "recrystallized" carborundum, which is prepared by agglomerating the finely divided material and reheating in the electric furnace, should be noted, as also that of Tone for using for similar purposes the "amorphous" variety, which always forms a considerable proportion of the product. Each of the carborundum furnaces in use at Niagara employs 1,000 horse power, the voltage starting at 200, and falling to 80 as the furnace heats up; the units are kept working at full power, the voltage being varied according to the progress of the reaction.

As is well known, the power is distributed by the Niagara Falls Power Company on the constant-pressure system, and it is therefore necessary to have some means by which this variation in the resistance of the furnace can be coped with. The two principal ways in which this can be accomplished are to change the ratio of the transformer, or to add in another small transformer which can be used as a booster; in either case it is necessary to deal with the primary, as the secondary connection for such large currents cannot easily be manipulated. Fig. 15 shows two of the most satisfactory ways of connecting for this purpose.†

Artificial Graphite.‡—It was during the development of the carborundum industry that Acheson's attention was drawn to the formation of graphite in his resistance furnace, a discovery which has since been applied on a large scale. Artificial graphite had been known since the work of Despretz in 1849, and from a commercial point of view had been produced by the Girard and Street process, which consists in passing the amorphous carbon through the electric arc. The Acheson process, however, is capable of dealing with the material in larger bulk and gives a pure graphite, containing as little as one-tenth per cent of ash. At first the work was limited to graphitizing articles of agglomerated amorphous carbon. Such graphite electrodes are quite indispensable for the success of many of the aqueous electrolytic processes, both on account of their more compact nature and of their greater stability.§

It is generally considered that the presence of small quantities of metallic oxides is indispensable for the graphitization of amorphous carbon; in fact Acheson has found that pure carbon submitted to the highest temperatures of his furnace remains untransformed. He has recently discovered, however, that there is no need for an intimate mixture of the carbon and metallic oxide, since the reaction can take place by a kind of cementation process if the two are roughly mixed together, the metal vapor easily permeating the material. The action appears to be a catalytic one, caused by the progressive formation and dissociation of metallic carbides, the presence of a small percentage of impurity thus being used time after time in the reaction. Girard and Street already in 1895 pointed out the part played by the metallic oxides in this reaction; they obtained, moreover, a fairly complete transformation of the amorphous carbon into graphite. Moissan, who has minutely studied the formation of graphite, has found that its properties vary largely according to the method of production; but the question is by no means exhausted, and it seems probable, since the requirements vary from case to case, that a careful study of the influence of individual impurities upon the graphite produced, may lead to the preparation of electrodes still more suited for any particular electrolysis than those at present manufactured. More recently this method has been applied to the direct graphitization of anthracite coals, with the production of a granular graphite, possessing very valuable properties for lubricating and similar purposes. Fig. 16 gives section of the furnaces used for graphitizing electrodes. So as to increase the resistance of the furnace and reduce the intensity of current necessary, the electrodes are laid transversely and are surrounded by a mixture of coke and carborundum. On the other hand, the resistance of the anthracite being initially high, a small core of carbon is inserted. The resistance of the furnace falls with the progress of the reaction, but is of course lower than in a carborundum furnace; the system of regulation is similar. The transformers first installed gave up to 37,000 amperes at between 30 and 15 volts on their secondary circuit, the leads being properly interlaced to bring up the power factor to a maximum. The frequency used at Niagara is as low as 25 ~ ; it is probable, however, that in installing a generating plant solely for such chemical work, an even lower frequency would be preferred. By the graphitizing process the conductivity is increased some fourfold; the density is also changed, rising from 1.5-1.90, that of amorphous carbon, to 2.1-2.250, that of graphite. Apart from the question of conductivity an important advantage of graphite is the ease with which it can be machined. It can be cut and planed with ordinary wood tools, and screwed without any difficulty. The American production, starting with 162,382 pounds in 1897, has increased to 2,500,000 pounds in 1901, about half this being in the form of electrodes. 1,000 horse power is employed in this manufacture, a number of furnaces being in use, each in taking the full power; the change over can be made in a few minutes.

We now pass to the consideration of aluminium, zinc, sodium, caustic soda, etc., which are primarily electrolytic processes, the heating effect of the current, though used to keep the cell in the molten condition, being of secondary importance. The electrolytic bath could of course in all cases be easily and more cheaply kept molten by means of an ordinary furnace, but these electrolytes are generally so corrosive in their action, that the wear and tear on the crucible would make such a process unworkable. The electrolyte when fused by the current itself usually remains solid around the walls of the furnace, and thus forms a protective layer.

(To be continued.)

* Kohn, Journ. Soc. Chem. Industry, vol. 16, p. 863 (1897).

† Peck, Electrochemical Industry, vol. 1, p. 5 (1902).

‡ Despretz, Comptes Rendus, vol. 29, p. 709 (1849); Berthelot, Ann. de Chim. et de Phys. (iv), vol. 19, p. 392; H. Moissan, Le Four Electrique, pp. 85-111; Girard and Street, Engl. Patent No. 13,340 of 1895, German Patent No. 78,926 of 1895; Street, Soc. Intern. des Electriciens, see Electrician, vol. 35, p. 542 (1895); E. G. Acheson, U. S. A. Patent No. 568,323 (1896); F. A. G. Fitzgerald, Journal Soc. Chem. Industry, vol. 20, p. 443 (1901); also Journal of Franklin Institute, December 11, 1896; Borchers, Zeitschr. fur Electrochemie, vol. 3, p. 368 (1897).

§ Sprfisser, Zeitschr. fur Electrochemie, vol. 7, p. 971, etc, (1901); Förster, Zeitschr. fur Electrochemie, vol. 8, p. 143 (1902).

ARE GLASS DRINKING-VESSELS INNOCUOUS?

IT is well known that glass has now almost completely replaced metal, horn, and leather for the bottle or drinking-cup, although it is not so very long ago that the leather bottle and horn drinking-cup were extant. Whether this change could possibly have introduced any prejudice to the common health is an interesting matter for speculation. It is not true, though it is commonly supposed to be so, that glass is unattacked or completely undissolved by water and many other fluids in household use. On the contrary, the indelible marks which often appear on a water-bottle arise from the action of the water upon the glass. Pure distilled water, showing neither an acid nor an alkaline reaction, which has been allowed to remain in a closed glass bottle for some time will gradually develop an alkaline reaction owing to the base of the mixed silicate of the glass dissolving in the water. At the same time a deposit of silica will generally be found at the bottom. This obviously shows a dissociation of constituents and the glass yields up its silica and its alkali to water. With acid fluids the same action may be observed and it is conceivable that with acid wines kept long in bottle some considerable action upon the glass may occur. Weak acid solutions cease to be acid after being kept in glass bottles for some time owing to the neutralization of the acids by the alkali of the glass, and at the same time a flocculent and generally iridescent deposit is found in the bottle, consisting of silica. This deposit is a constant source of trouble to druggists. Though the glass-dissolving power of most fluids in domestic use must be very small, yet considering that these fluids are continually in contact with glass, either in the bottle or the tumbler, there can be little doubt that traces of the constituents of glass are ingested. It has even been suggested that the practically universal use of glass in this way in the place of the old drinking-vessels of wood or horn or of the glass bottle for the leather or skin vessel has contributed a means of rendering the vermiform appendix easily liable to an inflammatory process by the irritation set up by siliceous particles. This ingenious theory of the increased prevalence of appendicitis being due to the universal use of glass for drinking-vessels can hardly be seriously regarded when it is considered that silica is a frequent constituent of a number of foods. As is well known silica is the support of the wheat stalk as lime associated with phosphates is of the human frame.—Lancet.

THE HISTORY OF PUBLISHING IN THE UNITED STATES.

THE publishing industry of this continent is older than most of us suspect. It dates back to within a century of printing. All accounts seem to agree that the printing press was introduced into Mexico about 1540. Seven books were printed in Peru before 1600. These interesting facts are brought out by Eugene Parsons in an article contributed to the "World To-day." Beginning with the earliest publication in New England, viz., "The Freeman's Oath," printed in 1639, the writer traces the beginning of American publishing during the Colonial period, and shows that before the Revolution 7,683 titles appeared, of which nine-tenths were pamphlets. The first American newspaper, "Publick Occurrences," appeared in Boston in 1690, and was promptly suppressed by the government of the colony. The second journal, the "News Letter," enjoyed a longer lease of life, although its circulation rarely exceeded 300 copies, and its contents were chiefly formal proclamations, verbose addresses and other official matter, announcements of the arrival and departure of vessels, and an occasional brief account of a fire or the death of a citizen. During the pre-Revolutionary period some seventy-eight newspapers were started in America, of which thirty-nine were in course of publication at the beginning of the war. The most influential of these was the Boston Gazette, established in 1719, which before the Revolution numbered among its contributors such ardent patriots as Samuel Adams, John Adams, and James Otis. Freedom of the press was not the least noteworthy of the results of the Revolution. A free press did not exist in England or elsewhere in the world for many years afterward. The first half-century of American national life saw the beginnings of American literature, and as a consequence of the book-publishing trade in the United States. Little, Brown & Co., of Boston, established in 1784, and J. B. Lippincott & Company, of Philadelphia, founded in 1798, are the two oldest houses of this character that still survive. Harper & Brothers, 1817, and D. Appleton & Company, 1825, were pioneers in the book trade in New York, now the center of the publishing industry in this country. The growth of the industry has been very rapid in the past few years. The number of books published in 1880 was 2,076, including reprints and pamphlets. In 1890 the total had grown to 4,559; in 1900 to 6,356, and in 1901 to 8,141. Of this last total 4,706 were copyright books by American authors, 2,122 books by English and other foreign authors and 1,318 English books imported in editions. The United States Census Bulletin of June 28, 1902, showed the number and circulation of newspapers and periodicals from 1850 to 1900, the number in the former year being 2,526, with a total circulation of 5,142,177, and in the latter year, 18,226 papers and periodicals, with a circulation of 4,681,113,530 copies. The total value of the printing product of the country now ranks with that of the three or four greatest industries, a fact that speaks well for the average intelligence of American citizens.

TRADE NOTES AND RECIPES.

Size for Gilding on Glass.—Put a few shreds of Russian isinglass into a pint of boiling water; when dissolved add an equal amount of alcohol and strain if necessary.—Druggists' Circular and Chemical Gazette.

Green Color for Perfumery.—Chlorophyl is a suitable agent for coloring liquid perfumes green. Care must be taken to procure an article freely soluble in the menstruum. As found in the market it is prepared (in form of solutions) for use in liquids strongly alcoholic; in water or weak alcohol; and in oils. Anilin greens of various kinds will answer the same purpose, but in a trial of any one of these it must be noted that very small quantities should be used as their tinctorial power is so great that liquids in which they are incautiously used may stain the handkerchief.

Color imparted by chlorophyl will be found fairly permanent we think; this term is a relative one, and not too much must be expected. Colors which may suffer but little change by long exposure to diffused light may fade perceptibly by short exposure to the direct light of the sun.

Anilin colors vary in their permanence, of course, being of varying composition.—Druggists' Circular and Chemical Gazette.

Metal Polishes.—The substances in general use for polishing metals are prepared chalk, rotten stone, tripoli, and emery. For the finest work jewelers' rouge is employed. This is prepared by calcining precipitated ferric oxide, until it assumes a scarlet color.

Substances like emery are most useful for the harder metals; they scratch too much to be used to any extent on gold or silver. All should be run through a fine sieve before being used.

As examples of mixtures containing other ingredients we give the following:

I.

Kieselguhr	80 parts
Oxide of tin	30 parts
Pipeclay	30 parts
Tartaric acid	3 parts

II.

Kieselguhr	28 parts
Pipeclay	10 parts
Sodium hyposulphite	3 parts
Ferric oxide	2 parts

Polishing pastes may be made as follows:

III.

Make Armenian bole into a paste with oleic acid.

IV.

Rotten stone	1 part
Iron subcarbonate	3 parts

Lard oil, a sufficient quantity.

V.

Iron oxide	10 parts
Pumice stone	32 parts

Oleic acid, a sufficient quantity.

VI.

Soap, cut fine	16 parts
Precipitated chalk	2 parts
Jewelers' rouge	1 part
Cream of tartar	1 part
Magnesium carbonate	1 part

Water, a sufficient quantity.

Dissolve the soap in the smallest quantity of water over a water bath. Add the other ingredients to the solution while still hot, stirring all the time to make sure of complete homogeneity. Pour the mass into a box with shallow sides, and afterward cut into cubes.

VII.

Petroleum jelly	42 parts
Refined paraffin	14 parts
Powdered bath brick	14 parts
Powdered pipeclay	14 parts
Powdered pumice	2 parts
Oleic acid	1 part

VIII.

Dried sodium carbonate	5 parts
Soap	20 parts
Emery, in very fine powder	100 parts

Water, enough to form a paste.

IX.

Dried sodium carbonate	5 parts
Soap	20 parts
Levigated emery	100 parts
Water	100 parts

Mix, put on a water bath and heat, under constant agitation, until a smooth homogeneous paste has been obtained.

X.

Jewelers' rouge.

Petrolatum, equal parts.

XI.

Emery flour	50 parts
Jewelers' rouge	50 parts
Mutton suet	40 parts
Oleic acid	40 parts
Petrolatum	1 part

Melt the suet and oleic acid together over a water bath, and when thoroughly mixed remove from the fire. When cooled but still soft, add the powders, and rub until they are evenly distributed throughout the mass.

As an example of a liquid cleanser and polish for ordinary use the following is given:

Prepared chalk	2 parts
Water of ammonia	2 parts
Water, sufficient to make	8 parts

The ammonia saponifies the grease usually present. It must be pointed out that the alkali present makes the preparation somewhat undesirable to handle as it will affect the skin if allowed too free contact.—Druggists' Circular and Chemical Gazette.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Commercial Travelers in Austria.—The regulations governing commercial travelers in Austria have recently been amended by a ministerial order. While the principle of state control is still maintained, many of the objectionable features, or rather interpretations, of the original statute have been modified.

As heretofore, orders for the following commodities may be solicited without license:

1. Machines, including motors, and parts thereof.
2. Building material, artificial stone, roofing felt, and artificial paving material.
3. Technical appliances for heating apparatus and light and water plants.
4. Wooden shutters and window blinds.
5. Sewing machines, typewriters, and bicycles.

Other provisions are:

All commercial travelers soliciting orders for other articles of merchandise than those enumerated above must be provided with a license. Licenses are issued by the provincial industrial boards, and application therefor must be made, either verbally or in writing, by the proprietors of establishments employing traveling salesmen. The fee to be paid for a license is 2 crowns (40.6 cents).

Unless a license is sooner revoked for cause, it remains valid until its owner severs his connection with the person or firm at whose instance it was granted.

A commercial traveler must always carry his license with him.

Whoever offers gold or silver watches or jewelry for sale must be provided, in addition to the license given him by the industrial board, with a special permit from the imperial assay office of the district in which he is registered. This document must be produced to and visaed by every assay officer in whose district its owner desires to do business. It authorizes the licensee to sell to dealers, and to dealers only, such gold and silver ware as bears the Austrian assay mark and no other. The sale of plated ware is prohibited and the supplies carried by salesmen are always subject to inspection and test by assay officials.

Traveling salesmen who are in the employ of mercantile or industrial firms are permitted to carry only samples of the goods which they offer for sale, and these samples must be marked by their employers as such.

No change has been made in the status of foreign salesmen, who now, as before, require only such documents as the commercial treaties with their respective countries stipulate.—Frank W. Hossfeld, Consul at Trieste.

Sawmills and Lumber in Cuba.—Many complaints have been made here relative to the lack of milling facilities for dressed lumber. A lumber dealer of this city, Mr. Hunter, states that there are only two small sawmills here, neither of much utility, and they charge exorbitant prices for dressing lumber—$9 per 1,000 feet. He has leased for four years, with the privilege of buying at the expiration of that time, the best milling site in Cienfuegos, and he offers this site free of rent to any enterprising American who will establish a modern sawmill here. He will promise the American all of his own sawing, and no doubt he would receive the work of the many large plantations in this province and that of the new Cuban Central Railroad. Mr. Hunter says that there is a great local demand for doors, window frames, and moldings at very profitable prices, these articles being now imported from the United States under heavy rates of duty.

The fact that an American firm has established a good sawmill in Habana and is now buying logs in this port and shipping them to the mill, paying freight rates equal to a shipment to the United States, makes it apparent that the establishment of a mill in this city under the conditions mentioned would be very profitable. My own investigations along this line substantiate Mr. Hunter's conclusions.

In connection herewith, I would mention that the two principal export woods of Cuba—mahogany and cedar—are steadily enhancing in value, and the holders of the choicest timber lands on the north coast, as well as those holding lands adjacent to the new Central Railroad, are advancing their prices. Nevertheless, there are good mahogany lands on the south coast of Cuba that may yet be bought at a low figure.—Max J. Baehr, Consul at Cienfuegos.

Sand Bricks in Germany.—Owing to numerous inquiries from persons in the United States as to further details of the manufacture in Germany of bricks made of sand and lime and described in reports from the former consul at Magdeburg,* the present consul, Mr. W. A. McKellip, was led to investigate the matter and prepare an elaborate report, which he transmitted through the Department of State to a firm which had requested full details, together with pamphlets and other exhibits. In this report, Consul McKellip expressed the opinion that patented processes are not now necessary in Germany in making this kind of bricks, and quotes authorities to show that other systems are used, for which no licenses are required. The consul adds:

Whether the process for combining lime and sand can and will be perfected, so that artificial stone or brick can be produced in our country for building and other purposes as cheaply (in view of durability and other qualities) as clay brick or natural stone, is a problem yet to be solved; it has not been satisfactorily determined in Germany. If it can be done, I doubt not that the scientific ability and inventive genius of Americans will so improve existing methods of making this stone as to finally settle the question.

The consul concludes by saying that persons who are interested can obtain full details as to present methods in Germany by addressing manufacturers of brick machinery in Germany, who will cheerfully give the necessary information. Among these manufacturers, Mr. McKellip mentions the Krupp Works, of Buckau; Messrs. Roehrig & Koenig, of Magdeburg-Sudenburg; the Association of Manufacturers of Lime and Sandstone, of Charlottenburg; Brueck, Kretschel & Co., of Osnabrück; and Stahl and Eisen Aktien Gesellschaft, of Hoerde (Westphalia).

Copper Sulphate Bids in Greece.—The Currant Bank of Greece has made public its decision with regard to the bids for the 1,000 tons of sulphate of copper referred to in my telegram of December 18, 1902,* and rejects all offers on the ground that the prices and terms submitted are not compatible with prevailing market conditions. The prices have not, of course, been made known, although it is generally understood that all bids were far in excess of the American bids of last year, and in most cases $10 to $15 per ton higher than what is considered an average retail price. American firms are not concerned in this matter, however, since the only firm that had a representative in the field prepared to meet the conditions was prevented from entering the contest at the last moment by the destruction of one of its largest plants.

It is to be regretted that other American firms should not have deemed it worth while to consider the proposition of the Currant Bank. There is no certain way of knowing the issue in such a case, but the facts seem to indicate that any American firm which could have met the conditions could also have underbidden European firms and secured the contract, and this view may be strengthened by a comparison of the successful American bid with the European ones of last year, in which the American was $5 per ton below the lowest European. The bank is now advertising for bids of any number of tons under 1,000, in the hope that it may procure the desired quantity at more acceptable figures.—Frank W. Jackson, Consul at Patras.

Opening for Paper Barrels in Greece.—Inquiries have been made at this consulate by one of the most extensive wine companies of Greece for the names of American manufacturers of barrels from paper. That such a process has been reached among our manufacturers I have no reason to doubt, as compressed paper has come to serve the purposes of wood, and occasionally of iron, in many instances, but in the lists of manufactured products on file in this office there is mentioned no factory of paper barrels. I shall be glad to have addresses for the wine companies here, in the hope that a profitable trade may be developed. One of the obstacles which the wine trade is constantly meeting is the expense connected with the importation of staves and casks. There is no timber suitable for local manufacture, so that exporters of currants, as well as manufacturers of wine, must depend entirely upon the foreign markets for their supply of staves. So far as I know, American firms have never succeeded in obtaining a hold upon this trade with Greece, although efforts were once made by firms in our Northwestern States to ship staves by vessels around Cape Horn. Their failure, if it was not due to some cause foreign to the trade—as for instance, to difficulties encountered in the negotiations—must have resulted from an inability to compete in transportation rates, since we have staves in unlimited quantities.—Frank W. Jackson, Consul at Patras.

Circulars for Germany.—Under date of February 4, 1903, Consul J. J. Langer writes from Solingen:

Advertising matter is frequently received by concerns here from manufacturers in the United States which, being in the English language, is of practically no value. A local hardware dealer some time ago received catalogues of wire fences. While he was interested, he could not understand the description, the sizes being expressed in inches and pounds, and, even after reducing these to the metric system, he could tell nothing of the detailed construction. He would not, he said, object to giving them a trial, but would not order them without knowing more about them. When an American manufacturer desires to introduce goods into this country, he should find some responsible agent to keep stock, or at least a full line of samples on hand, and let him introduce the article among the trade. Better still, of course, where larger sales come into consideration, is to send able salesmen who can speak the German language, select the houses they wish to deal with, and make arrangements as to terms, etc. If printed matter is used, it should certainly be in the language of the country to which it is sent.

Automobiles in Guadeloupe.—Consul L. H. Aymé, of Guadeloupe, under date of January 24, 1903, writes:

A daily automobile service has been established between this city and the town of Ste. Rose. This service is the first step toward the substitution throughout the colony of automobiles for the archaic stage coaches which were the only means of land transport. The Ste. Rose line began running January 1 and has proved a success. On March 1, two new lines will be established, one from this city to Basse Terre and the other from this city to Le Moule. The automobiles used are of French manufacture, with gasoline engines as motive power. They are well made, handsome vehicles and carry ten passengers besides the chauffeur and his assistant. The prices charged are about the same as for the old stage coaches.

New American Shoe Machines in England.—Seven of the new American shoe machines, which do the work known as "pulling over," have been introduced into Leicester, a great shoemaking place in this consular district, by the British United Shoe Machinery Company. Each of these machines displaces 12 workmen. By what is enthusiastically described as a "beautiful combination of power-driven and perfectly balanced spring pincers," it automatically takes all the stretch out of the upper of a boot, brings the whole into the perfect shape of the "last," and automatically fixes the upper to the insole. One machine, worked by a single operative and two or three boys doing simple preparing, "pulls over" 60 dozen pairs per day and can keep three consolidated lasting machines in full work. The operation of this machine has been a revelation to both employers and workmen at Leicester.

It is well known that English workmen are peculiarly antagonistic to, and well organized against, the introduction of labor-saving machinery. The new shoe machines are exceptionally open to the objections which they are accustomed to urge. Steps are therefore being taken to meet the workmen on some sort of compromise, with a view to which a conference between the National Boot Operatives' Union and the National Federation of Manufacturers is proposed.—Frank W. Mahin, Consul at Nottingham.

Opening for Dredge in Syria.—Consul W. R. Davis writes from Alexandretta, January 20, 1903:

The improvement commission is considering a new plan for reclaiming the marsh (about 6 square miles in area) that lies near this city. Part has been filled, and it is now proposed to dig a canal from the sea on the west of the town, which shall bend to the south and end at the sea on the east, being some 3 miles long, with a depth of 12 feet and a width of 50 feet, making it navigable for water craft of 100 to 200 tons burden. An allowance of 2,000 liras ($8,800) has been made, and the authorities seem to be willing to spend that sum for a dredge. Circulars or price lists of dredges should give cost c. i. f. at Alexandretta. Free on board at New York is not sufficient, as transshipments add much to the cost, and it is necessary that expenses be kept at the minimum.

Opening for Potato-Starch Machinery in Russia.—Vice-Consul Hernando de Soto writes from Warsaw, January 29, 1903:

I am reliably informed that 12 new factories for potato starch are in course of erection in this consular district, which is due to the large crops in this section of Russia. About 90 potato-starch factories are already in operation. There is a large demand for machinery for the manufacture of this starch, and there is a decided tendency to give preference to all foreign machinery other than German. I have been requested to obtain offers from American manufacturers as promptly as possible. Offers may be directed to Bronislaw Oderfeld, 17 Ujasdowska Aleja, Warsaw, who, I am informed, is a reliable agent. Prices should be stated f. o. b. New York, or if possible, delivered at Stettin, Germany.

Mosquito Screens in Lourenco Marquez.—Consul W. S. Hollis, of Lourenço Marquez, under date of December 16, 1902, reports that there is an opening for the sale of mosquito netting in that district. The consul says:

This place has long been noted for its mosquitoes and for its malarial fever. Until a year ago, the only nettings used were the canopies for beds. Recently, some of the foreign residents have had mosquito screens put in their doors and windows, and this idea is now beginning to gain popularity. I would suggest that American manufacturers of mosquito nettings, as well as manufacturers of screen doors and window screens, send samples of their different makes, with complete price lists, to this consulate. They will be placed before interested parties.

Demand for American Peanuts in France.—Consul-General R. P. Skinner, of Marseilles, under date of January 31, 1903, says:

I am in receipt of inquiries from local importers for the addresses of exporters in considerable quantities of American peanuts. During last year, some 10,000 bags were received in Marseilles, and the oil into which they were manufactured was of good quality, although the quantity was rather less than that derived from the same weight of African nuts. The demand here is practically unlimited, if American exporters can meet prevailing prices. At the present time, these prices range from $3.95 to $4.73 per 220 pounds c. i. f. for African nuts in the shell. It is the understanding in Marseilles that the production in the United States is increasing very rapidly, and that there will be annually increasing quantities for export from America.

International Dairy Congress at Brussels.—Consul G. W. Roosevelt reports from Brussels, January 28, 1903:

The National Dairy Association of Belgium has decided to hold an international congress at Brussels during the month of September, 1903, immediately after the Eleventh Congress of Hygiene and Demography. The dairy congress will discuss the principal subjects now interesting the dairy world, and especially those of international importance, such as—

1. International convention for the repression of fraud in the butter and margarine industry.
2. Hygiene of milk and milk products.
3. Creation of an international dairy association.

Opening for Dredge in Russia.—Vice-Consul H. De Soto reports from Warsaw, February 7, 1903, that L. Chelminski, an engineer residing at No. 5 m. 7 Mokotowska, Warsaw, desires to import dredges for river work, and wishes to obtain quotations from American manufacturers.

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No. 1584, March 3.—*Opening for Paper Barrels in Greece—Minerals in Australasia—Gold Production of Australasia—Export of Poultry and Other Meat from New South Wales—Brazilian Cacao Crop in 1902—Steel Plant at Monterey, Mexico.

No. 1585, March 4.—The Year's Record in Germany—Trade at Santiago de Cuba—Steamship Line Between Rotterdam and Montreal—American Steel Factory at Flushing.

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No. 1588, March 7.—German Firms in China—Cotton Crop of India in 1902-3—*Copper Sulphate Bids in Greece—*Sand Bricks in Germany—Reconstructed Shipyards in Stettin—New Industry for the Blind.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

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* Advance Sheets No. 900 (March 21, 1901) and No. 1286 (March 11, 1902).

* Advance Sheets No. 1525 (December 20, 1902); see also Advance Sheets No. 1538 (January 23, 1903).

SELECTED FORMULÆ.

Camphorated Cold Cream.—

Oil of sweet almonds	8 fl. ounces
White wax	1 ounce
Spermaceti	1 ounce
Camphor	1 ounce
Rosewater	5 fl. ounces
Borax (in fine powd.)	4 drachms
Oil of rose	10 drops

Melt the wax and spermaceti, add the oil of sweet almonds, in which the camphor has been dissolved with very gentle heat; then gradually add the rosewater, in which the borax has previously been dissolved, beating or agitating constantly with a wooden spatula until cold. Lastly add the oil of rose.—Pharmaceutical Era.

Metal Polishing Pomades.—

I.

Dehydrated soda	5 parts
Curd soap	20 parts
Emery flour	100 parts

To be stirred together in a water-bath with water 100 parts until of soft consistence.

II.

Turpentine	1 part
Emery flour	1 part
Paris red	2 parts
Vaseline	2 parts

Mix well and perfume.

III.

Stearine	8 to 9 parts
Mutton suet	32 to 38 parts
Stearine oil	2 to 2.5 parts

Melt together and mix with Vienna chalk, in fine powder, 48 to 60 parts; Paris red, 20 parts.—Journ. d. Goldschmied.

Almond Powder for the Toilet.—

I.

Almond meal	6	kilos
Bran meal	3	kilos
Soap powder	0.6	kilos
Bergamot oil	50	grammes
Lemon oil	15	grammes
Clove oil	15	grammes
Neroli oil	6	grammes

II.

Almond meal	7	kilos
Bran meal	2	kilos
Violet root	0.9	kilos
Borax	0.35	kilos
Bitter almond oil	18	grammes
Palma rosa oil	36	grammes
Bergamot oil	10	grammes

III.

Almond meal	3	kilos
Bran meal	3	kilos
Wheat flour	3	kilos
Sand	0.9	kilos
Lemon oil	40	grammes
Bitter almond oil	10	grammes

—Druggists' Circular and Chemical Gazette.

Dentifrice.—

Star anise	25 parts
Cinnamon	25 parts
Cloves	25 parts
Oil of anise	5 parts
Oil of peppermint	10 parts
Cochineal	5 parts
Alcohol	2,000 parts

—Druggists' Circular and Chemical Gazette.

Bronze Paint.—

Turpentine spirit	6 pints
Copal varnish	1 pint
Bronze powder	6½ pounds
Dried slaked lime	½ ounce

Mix the turpentine and varnish, add the lime and agitate well, repeating the agitation several times at intervals as the lime settles. Then allow to settle, pour off the clear liquid and mix with it the bronze powder.

The object of using the lime is to neutralize any acid present in the varnish, such acid causing bronze to become discolored. To determine how effectively this has been done the varnish may be chemically tested.—The Druggists' Circular and Chemical Gazette.

Flavoring for Dentifrice.—

Sassafras oil, true	1 drachm
Pinus pumilio oil	20 minims
Bitter orange oil	20 minims
Wintergreen oil	2 minims
Anise oil	4 minims
Rose geranium oil	1 minim
Alcohol	1 ounce

[illegible] according to taste.

Ink for Copying Without a Press.—

Aniline blue	15 grains
Alum	8 grains
Glycerine	1 ounce
Water to make	4 ounces

—Druggists' Circular and Chemical Gazette.

Some Substances Which Give Fluorescent Liquids.—

Æsculin gives pale blue by (1) reflected light, straw color by (2) transmitted light.

Amido-phthalic acid, pale violet (1), pale yellow (2).

Amido-terephthalic acid, bright-green (1), pale green (2).

Eosin, yellow-green (1), orange (2).

Fluorescein, intense green (1), orange-yellow (2).

Fraxin, blue-green (1), pale green (2).

Magdala red, opaque scarlet (1), brilliant carmine (2).

Quinine, pale blue (1), no color (2).

Safranine, yellow-red (1); crimson (2).

—Druggists' Circular and Chemical Gazette.

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